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ALBERT STOWELL FLINT.

By JOEL STEBBINS.

In the present day conditions of life in America it is increasingly difficult to attract young men to the kind of scientific career which involves long and arduous application to a single large piece of investigation, where the worker must continue for years before he can have the satisfaction of seeing the results of his labor unfold. Such an investigator was Albert S. Flint, who in his thirty-year connection with the Washburn Observatory devoted his attention to about half a dozen pieces of work, each extending over some years, and which he carried through with rare persistence and application.

Professor Flint was born in Salem, Massachusetts, on September 12, 1853, son of Simeon Flint, a business man, and Ellen Rebecca Pollard, who were both from old New England families. There was perhaps not much in his youth to indicate his future choice of career, except that as a boy he was interested in the stars and learned the constellations as a matter of recreation. On entering Harvard he pursued the good solid classical course with no particular scientific study, except in mathematics where he became interested in the more advanced college courses. Upon graduation in 1875, he taught school for a time in California, but this was not particularly to his liking and he returned east to the Massachusetts Institute of Technology, where he commenced the study of mechanical engineering.

It was shortly after this that he discovered his true vocation, and we find him attracted to that fine teacher, Professor Charles A. Young, at Princeton. Here he received his first practical training in astronomy, and he became committed to the profession. He next studied with Professor Ormond Stone at Cincinnati, who at that time had developed a school of young astronomers, including Winslow Upton, W. W. Payne, H. A. Howe, and H. V. Egbert. From Cincinnati Flint went in 1881 to Washington, and for the next eight years held the position of computer in the U. S. Naval Observatory, at first on the staff of the observatory, then for the U. S. Transit of Venus Commission.

In 1887 the Naval Observatory was in process of transfer to a new site, and as the instruments at Washington were temporarily out of

commission the authorities of the University of Wisconsin offered to place part of the equipment of the Washburn Observatory at the disposal of the staff of the Naval Observatory. On this invitation Professor S. J. Brown came to Madison to undertake a series of observations with the meridian circle, and he was followed in 1889 by Flint, who with H. V. Egbert acted as assistant on this work. On Brown's return to Washington in 1890, it devolved upon Flint to finish the reductions and make supplementary series of observations to complete the program, which was for the purpose of improving the positions of the secondary stars in Auwer's Fundamental Catalog.

For the next thirty years Flint was to continue the work thus begun with the Madison meridian circle. In 1892 he collaborated with Director George C. Comstock in a series of position observations of Mars at the opposition of that year, and also with Professor Comstock in the latter's observing program in connection with the determination of the constant of aberration by means of the Loewy prism apparatus attached to the six-inch equatorial. Flint also determined the right ascensions of the stars used in this aberration work.

In 1893 Flint began his first major program for determination of the parallax of stars by means of the meridian circle. This method was first successfully used by Kapteyn at the Leiden Observatory, and as carried out by Flint consisted of the reference of each "parallax star" to two comparison stars, at about the same declination, one preceding and one following, the differences in right ascensions being recorded chronographically with key signals, each star being observed over twenty-five threads. The light of the brighter parallax stars was cut down by one or more wire gauze screens. The observations were begun in 1893 and completed three years later, and in 1902 the results had been worked out and published as Volume 11 of the *Publications of the Washburn Observatory*. All of the observing, the reading of the chronograph sheets, and the greater part of the reductions were done by Flint himself. In this series for the parallaxes of about one hundred stars, Flint detected a systematic error in the results, depending principally upon the outstanding difference in brightness between the comparison stars and the parallax star as reduced by the screen. Although a magnitude error of this sort in the personal equation is well recognized in meridian astronomy, it is only for a skilled and conscientious observer that such an evaluation of this error can be made as was done for his own work by Flint.

It is easy at the present to forget the status of stellar parallax determinations a quarter of a century ago, before the modern giant telescopes had been applied to this problem. Flint's results for a hundred stars were secured with an instrument of less than five inches aperture and of five feet focal length, but their importance may best be realized by reference to the judgment of an acknowledged master

in this field. In his well known paper on the distances of stars in *Groningen Publications* No. 8, Kapteyn makes the following statement: "A second list contains the very numerous parallaxes determined by Flint with the meridian circle. By the extreme courtesy of Mr. Flint I am enabled to use his results, though they have not as yet been published. As will be seen in what follows, these extremely valuable determinations have largely contributed to the accuracy of my results, and I gratefully acknowledge that it was mainly the confidence gained by the practical confirmation of my provisional results by Flint's work, which induced me to publish the present paper without further delay."

Kapteyn also gave a definite measure of his appreciation of the value of this work by assigning to Flint's parallaxes a total weight equal to two-thirds the total weight of all other parallaxes available at that time. In other words, in the matter of measured stellar distances suitable for a statistical study, Flint single handed had contributed two-thirds as much information as had been secured in half a century at all other observatories of the world.

In 1898 Flint undertook another long series of parallax determinations. In view of his experience in the earlier work, it was determined to eliminate as far as possible any chance for systematic error. In the new series the light of all parallax and comparison stars was reduced to an approximate equality by means of a slat-screen apparatus which was designed by Professor Comstock. This device, placed immediately in front of the objective, enabled the observer to diminish the apparent brightness of each star to a definite standard and thus eliminate any magnitude effect. There was also put into use the self-recording transit micrometer, which further reduced the possibility of any outstanding error of personal equation. The second list included about one hundred and twenty-five stars, selected not primarily for probable nearness, but in a manner that the results would be especially valuable for statistical study, whether the parallaxes should come out large or small. The observations extended over seven years, and it required another seven years of labor before all of the necessary reductions were made. The results have been published in *Astronomical Journal*, No. 631, and in more detail in *Publications of the Washburn Observatory*, Volume 13, Part 1. The second series of parallaxes turned out superior to the first, as was expected, and the two series together represent a herculean labor which is not easily appreciated.

Students of astronomy should remember that the program of a parallax observer requires that he must literally burn the candle at both ends. For years Flint began his observing at dusk and continued to about 9 P. M.; there was then a pause until 3 A. M., when work was continued until dawn. This program, conscientiously followed for practically every clear night, meant the renunciation of a great deal that makes life attractive in a modern community, and would be under-

taken only by a true devotee of science. The tremendous labor of reading the chronograph sheets and carrying out the necessary numerical work also stands as evidence of Flint's industry. Although he had assistance in the routine work, his own vigilant care followed every detail so that no preventable inaccuracy should creep in.

Before the long continued task of reduction of the second parallax series was completed, the photographic method of parallax determination with long-focus telescopes was being perfected, and with the increased number of observers in this field Flint saw the importance of his own work relatively but not absolutely diminished. He accepted this progress in science in the best of spirit, and entertained no jealousy toward the new workers who were encroaching upon his domain.

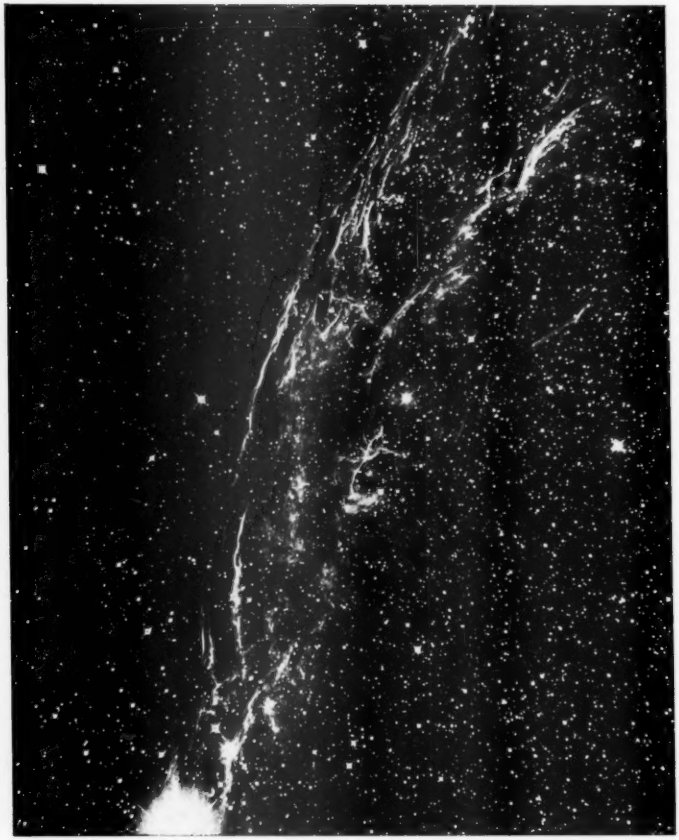
After the parallax observing was completed, and although having earned a rest from night work, Flint undertook several more tasks with the meridian circle. He contributed the necessary current observations needed by Profesor Comstock in the investigation of proper motions of faint stars, and also made a series of star-place determinations in coöperation with the Department of Meridian Astrometry of the Carnegie Institution. Such of this unpublished work as is not already in form for the printer is in an advanced state of preparation and will be carried forward to completion.

In spite of the confining nature of his duties, Flint found time to contribute his part to various local activities. He served for some time as secretary and editor for the Wisconsin Academy of Sciences, and took a great interest in thus promoting the scientific work of others. His principal outdoor recreations were rowing and tramping. He was much interested in good music, and perhaps the only event which would cause him to miss a clear night at the observatory was a concert by the choral society of which he was a member. His continued association for many years with a congenial group interested in poetry is another illustration of the fine fibre of his nature. He was an active member of the Unitarian church, and contributed much in personal effort to this organization.

In 1920 Flint retired from active service, though he still maintained a work place in the observatory. About a year after his retirement he became afflicted with a slowly increasing paralysis which curtailed his physical activity, but he kept his mental faculties well to the end, passing away peacefully on February 22, 1923, at the age of sixty-nine.

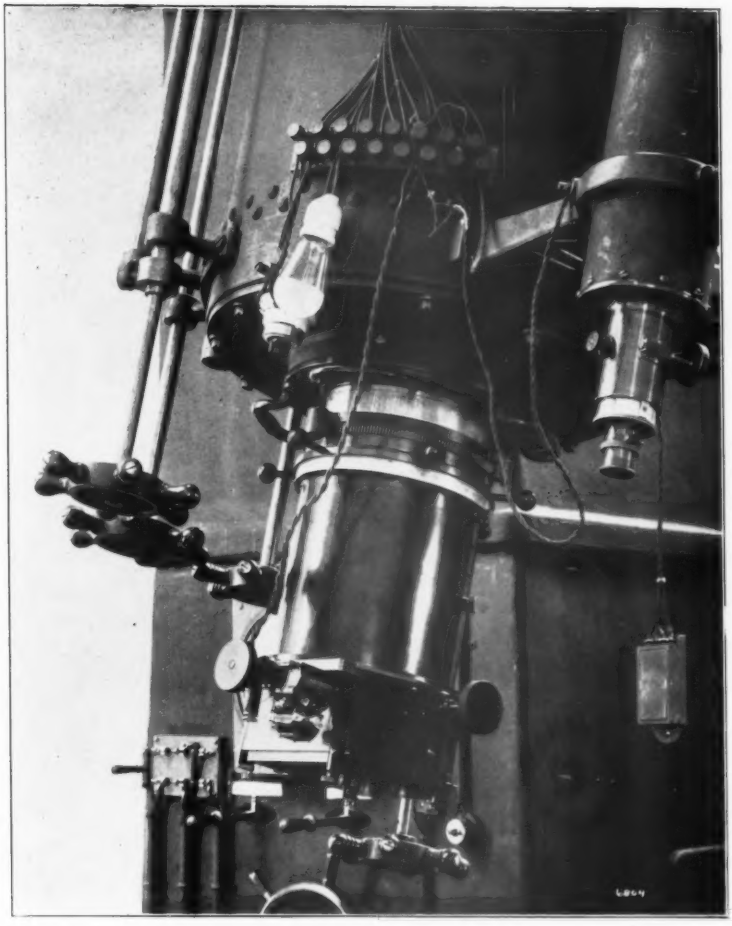
Flint was married in 1884 to Helen A. Thomas of Washington, D. C., and is survived by his wife, a son, and two daughters, one of whom married Professor L. R. Ingersoll of the Department of Physics, University of Wisconsin.

PLATE XXI



SOUTHERN PART OF THE NETWORK NEBULA IN CYGNUS.
Photographed at the Mount Wilson Observatory; exposure 12 hours.

PLATE XXII



MOVABLE PLATEHOLDER ON THE 24-INCH TELESCOPE OF THE SPROUL OBSERVATORY.

ASTRONOMY AND PHOTOGRAPHY*.

By JAMES STOKLEY, Jr.

When, for the first time in the history of the world, Daguerre made the light from an object record its own image on the sensitive photographic surface, he is said to have predicted some of the applications which his discovery would find in later years, but it is doubtful whether in even his wildest dreams he ever had a glimmering of its potentialities. Today there is scarcely a phase of human activity in which photography has not been able to play a useful role. Astronomy, while the oldest of the sciences, has ever been ready to take advantage of new discoveries and inventions, and it is not surprising that efforts were made to photograph objects in the heavens in the very earliest days of photography.

Daguerre himself made the first attempt to photograph the stars, and while he was not very successful, he at least made the beginning. He was not interested in the stars as an astronomer, however, and the first astronomical photograph to be made by scientists for astronomical purposes was taken on April 2, 1845, by the French physicists, Fizeau and Foucault. In our own country, W. C. Bond, then director of the Harvard College Observatory, made a daguerreotype of the moon in 1850 which was remarkably good when we consider his facilities. In the same year, he also photographed the bright star Vega.

As with all photography, the chief desideratum in the sensitive material used in astronomy is high sensitivity, and the great deficiency of the daguerreotype in this respect prevented its attaining wide application. The introduction of the silver bromide emulsion, in the wet collodion and albumen plates, both of which were much more sensitive than previous methods, enabled the astronomers to photograph far fainter objects than they had previously been able to record. Dr. Henry Draper and Lewis M. Rutherford, both of New York, made many fine photographs of the moon which for many years were unexcelled. In addition, the latter made numerous star photographs, the great scientific value of which was not realized until later, after they had been measured.

In 1871, the Englishman, Maddox, invented the gelatine dry plate, and a new epoch began in both celestial and terrestrial photography. The first astronomer to use the dry plate was Sir William Huggins, who in 1876 photographed with it the spectrum of Vega. The first photograph of a comet was made in 1881 by Draper, of Tebbutt's comet, and the following year a splendid photograph of the "Great

*A paper read before the Camden Astronomical Society, January 11, 1923.

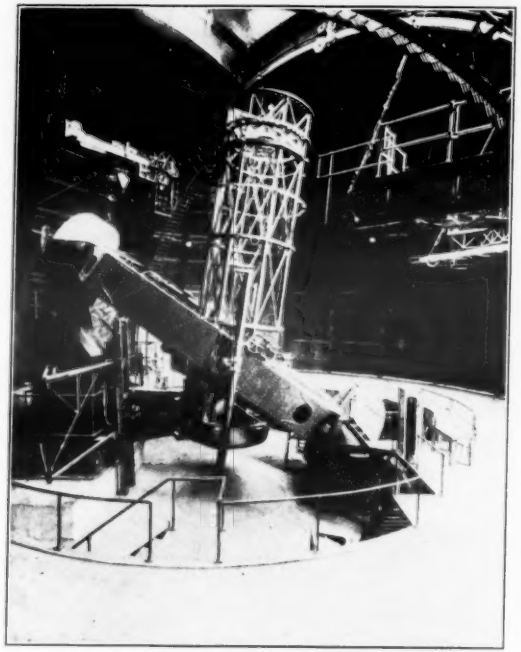
Comet of 1882" was made at the British Royal Observatory at the Cape of Good Hope. This was taken by Sir David Gill, the director, with the assistance of a local portrait photographer by the name of Allis. Since they had no special photographic equipment, they made the picture by attaching one of Allis's cameras to the tube of their large equatorial refractor.

The dry plate soon manifested many advantages. In addition to its greater sensitivity, the great superiority of the dry plate is that it enables long exposures to be made. Since the collodion plate had to be exposed while it was wet, the length of its exposure was limited, but the dry plate may be exposed for many hours if necessary. The utility of the long exposure is found in the property of the plate of summing up light impressions. The retina of the eye bases its judgment of illumination solely on intensity, and we are not enabled to see a faint star better after looking at it for an hour than after a tenth of a second. In fact, the visual acuity is diminished because of fatigue. The photographic plate, however, does not get tired, and it is able to see more, the longer it looks. If a certain amount of light will produce a fully timed negative in one minute, half as much light will produce it in about two minutes, and any fraction of the amount with a corresponding increase of exposure.

By simply exposing for longer and longer periods, therefore, fainter and fainter objects may be recorded, objects often too faint to be seen with the eye even when aided by the most powerful telescope. Such an object in the "Network Nebula" in Cygnus, shown in Plate XXI. As may be seen, it is full of fine detail, but is invisible to the eye. An exposure of twelve hours, on two successive nights, enables us to appreciate its great beauty. There is much in the sky of this nature that has never been seen, but the existence of which has been demonstrated photographically.

There are other advantages which the dry plate has over previous processes. One is the small degree of distortion of the film during development. It is obvious that if the plate is to be used after development for the purpose of measuring the distance on it between two stars, for example, any such distortion of the film will greatly diminish the accuracy of the results. With the wet plates, this factor was often sufficient to entirely invalidate any measurements. Moreover, such small distortions as do occur with the dry plate may be made partly harmless if we photograph a fine reticule or network composed of intersecting straight lines on the plate before development and after it has been exposed to the celestial object. This was not so easily possible with the collodion plate, which had to be wet while exposing. Further, the dry plates may be kept in a sensitive condition for almost any length of time after their preparation; they are easily handled, permitting their use by a person unskilled in photography; and they

PLATE XXIII



THE 100-INCH REFLECTING TELESCOPE OF THE MOUNT WILSON OBSERVATORY.

THE 150-FT. TOWER TELESCOPE ON MOUNT WILSON.

PLATE XXIV

THE GREAT SPIRAL NEBULA M 51 IN THE CONSTELLATION CANES VENATICI.

Photographed at the Mount Wilson Solar Observatory with the 60-inch Reflector; exposure $10^h\ 45^m$.

are less subject to mechanical injuries than the wet plates. It is therefore apparent, that without the advent of the dry plate, astro-photography would never have risen to its present great heights, and astronomy would have been seriously handicapped.

As the sensitive material used in photography has improved, there has been a corresponding improvement in the optical and astronomical branches of astronomy. Some of these will be mentioned later in greater detail when we consider the various special applications of photography, but we may mention here the great improvements in objectives. At first the only objectives available for photography were the ordinary visual ones, but these only focussed the yellow or visual rays sharply. The image of a star might appear sharp to the eye, but a sharp photograph could not be obtained of it with the ordinary plates. Ritchey overcame this difficulty by the simple but ingenious expedient of exposing the plate behind a screen which passed only the yellow rays and using isochromatic plates which were sensitive to this part of the spectrum. However, the use of a color screen reduces the amount of available light, which, except in photography of the sun, is never too great, and the best procedure is the use of a photographic objective. Such a lens focusses the blue or photographic rays sharply, and by the use of the newer kinds of glass, and of two or more lenses in combination (doublets or triplets), the ratio of the aperture to the focal length (relative aperture) may be made very high. It may be as great as 1 : 10, or as it is expressed, F. 10; and in the case of certain instruments used where high magnifications are not required, as in the photography of parts of the Milky Way, large nebulae, etc., it may be as high as F. 3.

Some of the first astronomical photographs were of the sun, and, in view of the great importance of this star to earth dwellers, it has long been the subject of special investigation. In the photography of it, the great abundance of light makes unnecessary great sensitivity, and in fact requires special apparatus to give sufficiently short exposures. Special instruments are used, called *heliographs*, and consist usually of a permanently mounted objective, at the focus of which is provided apparatus for holding the plate. In front of the objective is a heliostat, a mirror moved by clockwork, by means of which the sunlight may be reflected into the telescope tube for any length of time. Frequently no tube at all is used as with the Snow horizontal telescope at Mount Wilson. The objective is at one end, and the shutter and plate holder are inside a shelter at the other end. The shutter is of the focal plane type and consists of a dark slide in which is a narrow and adjustable slit. This is immediately in front of the plate, and the slit may be moved very rapidly across the plate by means of a strong spring, thus exposing successive parts of the plate for brief intervals. The exposure does not exceed 1/1000 of a second with even a slow

silver chloride emulsion. Such instruments are in use in various parts of the world, as at Meudon, Greenwich, Mount Wilson, etc., and are used almost daily to record sun-spots. Janssen, at Meudon, devoted his entire life to this phase of astro-photography, and produced some of the best results.

In photographing other objects, and, in a way, in photographing the the sun, atmospheric disturbances often produce a deleterious effect. There occur in the atmosphere layers of different density, due to variations in temperature, and as the boundaries of these layers are more or less curved, they may act as weak lenses, thus producing an effect similar to an increase or decrease in the focus of the objective, so that the image appears sharp only at brief intervals. In addition there is often a dancing of the image, which itself may be relatively sharp, from one place to another. A skilled observer may observe and measure accurately despite this unsteadiness, but when prolonged exposures are given to a photograph, it prevents the obtaining of a sharp image. With instantaneous exposures, as with the sun, the image may be sharp, but be distorted as a result of these effects. Star images are least affected, because they ordinarily appear as small discs, and unsteadiness merely produces a slight enlargement.

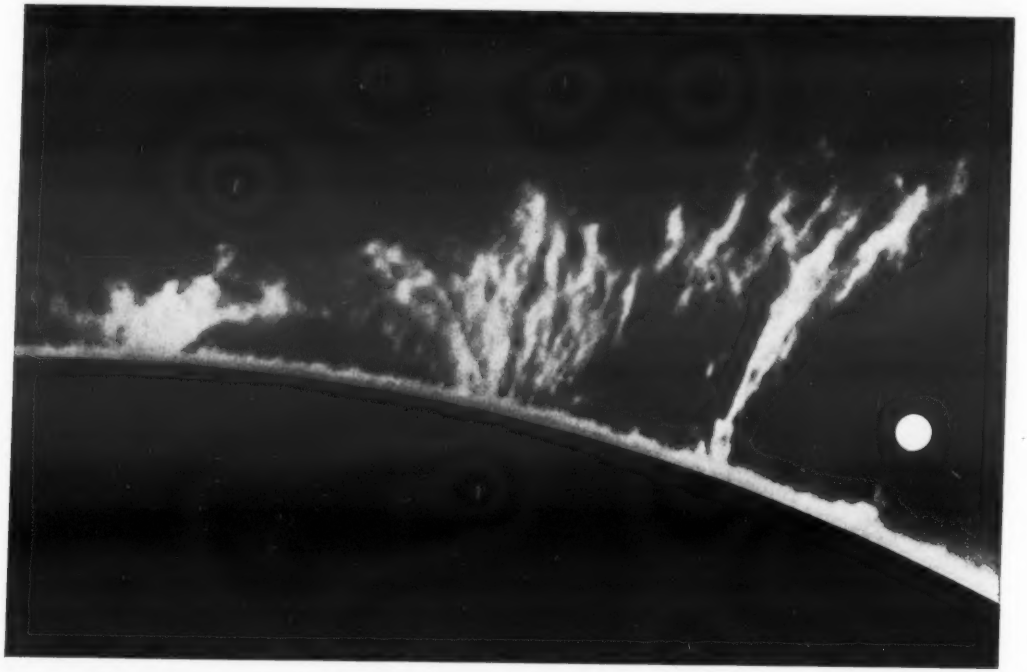
Next to the sun, the moon has probably been photographed oftenest, because of its relatively bright illumination. Even so, atmospheric conditions seldom permit absolutely sharp pictures to be made, and it is only by making many exposures that a good one may occasionally be obtained. Loewy and Puiseux, at the Paris Observatory proceeded in this manner, and their results, which are published in their excellent moon atlas, were not equalled until Ritchey made a series of such pictures at the Yerkes Observatory. On the night of September 15, 1919, when the 100-inch reflector at Mount Wilson was turned on our satellite, probably the best pictures ever made of it were obtained (See Plates II and III, POPULAR ASTRONOMY, January 1923). When photographing fine details on the moon's surface, the high magnification required magnifies the irregularities of the atmosphere as well. This difficulty is also met with in the photography of the planets, because these objects are all so distant that high magnification is always required. Lowell, Slipher, Barnard and Wood, in this country, have produced some of the best photographs of planets, but even these do not show nearly the detail that may be seen with the eye under favorable conditions.

When exposures of long duration must be made, it is necessary for the observer to keep the telescope pointed to the object being photographed. Even the best of mountings and clockworks is unable to keep the image of a star in the same place for a considerable length of time. This is partly on account of the fact that, as the star's altitude changes, there is a change in the refraction of the atmosphere. A

THE GREAT NEBULA IN ORION.
Photographed with the 100-inch reflector at Mount Wilson.

THE GREAT NEBULA IN ORION.
Drawn by G. P. Bond.

PLATE XXVI



SOLAR PROMINENCE 80,000 MILES HIGH

Photographed at the Mount Wilson Solar Observatory, August 21, 1909.
The white disc represents the earth on the same scale.

double telescope is frequently used, in which an auxiliary visual lens is used, in a tube attached to the photographic objective. At the focus of the visual objective is an ocular provided with a pair of cross-hairs. By means of the slow motions of the telescope, the observer keeps these cross-hairs on the star, or one of the stars, being photographed. Where it is not desired to use a double telescope, another device is sometimes used. The plate holder is made movable in two directions perpendicular to each other and to the optical axis, by means of micrometer screws. Attached to it, and moving with it, is an ocular provided with the cross-hairs. The observer keeps these hairs on a star, as near as possible to the object being photographed, by means of the screws, and the plate is thus kept in the proper position. Plate XXII shows such an attachment on the 24-inch telescope of the Sproul Observatory at Swarthmore College.

The refracting telescope is the most common one for photographic use, although the reflector is often employed. When a telescope of relatively small field of view is sufficient, the visual refractor may be used, placing a yellow screen in front of the plate as described before. This has the advantage of great focal length, and it was in this way that Schlesinger made his determinations of stellar parallaxes with the great 40-inch telescope at the Yerkes Observatory. It is also the method used at Swarthmore.

Just as maps are essential to the terrestrial navigator, so are star charts essential to astronomers; and their value is largely dependent upon their accuracy. During the nineteenth century, Argelander, in Germany, made one of the greatest of these, the "Durchmusterung." Working with two assistants, he gave almost his entire life to it and charted over 340,000 separate stars. It was truly a monumental work, for to do it, he had to observe each separate star through his telescope, measure and plot it. When Gill made the photograph mentioned above, of the great comet of 1882, he noticed that his plates were filled with star images in the background. As he had gone to the Cape for the purpose, among others, of making star charts of the stars visible in the southern hemisphere, he decided then to do it photographically.

In six years Gill's work was completed, and by 1900 the entire set of charts had been published. These show over 450,000 separate stars, nearly half again as many as in the Durchmusterung. The work had been completed within fifteen years, and with an accuracy greater than if the human element had been involved in the plotting. Since then, nearly the entire sky has been charted photographically by observatories in many parts of the world, working together. About 22,000 separate plates have been made and the number of stars shown in them is innumerable. They will be of great value in future times, as well as at present, and by repeating the charting periodically, changes in the heavens may be detected when the new plates are compared with the old.

Besides their utility for charting, the objectives of large field of view are used to advantage in hunting asteroids. In this work, the telescope is kept pointed at a star in the region being examined, and the photograph made. After an exposure of possibly two hours, the plate is developed, and the stars are seen on it as small discs. If an asteroid was present, it moved with respect to the stars and will be seen on the plate as a short line. Measurement of the plate and reduction will reveal by comparison with ephemerides, whether or not it is already known. M. Wolf, at the Heidelberg Observatory, has been a very prolific discoverer of these objects by photography. Mr. Metcalf, an American amateur, has also contributed the discoveries of many of them by the use of a slightly different method. He moves the telescope with a motion approximating that of the average asteroid. Thus the stars are shown as trails, and an asteroid, if present, will be revealed by a point, or at least a shorter line. This has the advantage that the image of the asteroid remains on one part of the plate for a longer time, and is thus more fully exposed.

Much good work has been done with the reflecting telescope, especially in the photography of nebulae, star clusters, and such objects. The 100-inch telescope at Mount Wilson, shown in Plate XXIII, has been of great utility in this way. The image, being formed by reflection from the large concave mirror, consists of light rays which have not passed through glass, and thus are rich in the ultra-violet. It is very actinic and thus the light power of a reflector is greater for photography than a refractor of the same aperture. In addition, the mirror is completely achromatic. Plate XXIV shows the great spiral nebula in the constellation of Canes Venatici, known as Messier 51, as photographed with the 100-inch telescope, and Plate XXV shows the great nebula in Orion, taken with the same instrument. The lower picture on Plate XXV shows a drawing of this object made by Bond, and reveals the great inferiority of the drawing to the photograph.

Not only has astrophotography resulted in an improvement of the older astronomical methods, but its application to the spectroscope has opened up an entirely new field, and one in which many of the greatest advances in modern astronomy have been made. While the spectroscope was used on stars before the application of photography, the light of even Sirius, the brightest star other than the sun, is so feeble that by the time we pass it through a prism, the resulting spectrum is so faint that we can see only the most prominent lines. It is here that the property of the photographic plate of summing up light impressions manifests its great advantage, and by giving sufficiently long exposures, even faint star spectra may be photographed. By using several prisms after each other, the resulting spectrum is greatly spread out and fine details may be seen in it, but there is a very great diminution of the light. A long exposure photograph, however, will permit

the use of such a compound spectroscope. Another arrangement often used for astrospectrography is the objective prism. With this, the prism is placed in front of the telescope, and thus the spectra of an entire constellation may be obtained on a single plate.

Spectrophotography has proved of especial value in photographing the sun. Since the prominences of the sun, those immense "flames" which shoot out from its surface, are of a gaseous nature, their spectrum consists of bright lines; that is, it is bright where the rest of the sun is dark. As a result, it is possible to see the prominences through the spectroscope attached to the telescope. Plate XXVI shows a prominence on the sun photographed at the Mount Wilson Observatory. This is 80,000 miles high, and the small white disc represents the earth on the same scale.

The recognized utility of the spectroscope for showing the prominences led astronomers to desire to be able to photograph the entire sun with the spectroscope. Many unsuccessful attempts were made to do this, but finally Hale solved the problem, simultaneously with Deslandres at Meudon. Hale called his invention the *spectroheliograph*, and while it has been constructed in several different ways, the essential features are the same. Plate XXVII is from a photograph of the Rumford spectroheliograph at the Yerkes Observatory. It is used in connection with the 40-inch telescope.

The image of the sun is allowed to fall on the slit, longer than its own diameter, of the spectroscope; and the solar spectrum is formed in the usual manner, showing all the Fraunhofer lines. A dark slide containing an adjustable slit is placed in front of the plate holder, at the focus of the spectroscope, so that the slit will correspond with one of the spectral lines. While the line is dark compared with the rest of the spectrum, there is still much light of the color corresponding to it present, and only the light of this color reaches the plate. If then, by a suitable mechanism, the first slit is moved across the image of the sun in a direction perpendicular to the optical axis, the Fraunhofer lines will also move, and if the second slit in front of the plate is arranged to move with them, it will be seen that the plate will be illuminated, one part after another, by the light of the same spectral line. If the K calcium line is used, as it is frequently, the photograph will then show as light areas the places where calcium vapor is present. In this way, also, any line of any element may be used, and the photograph will show the distribution of that element on the sun. Plate XXVIII is a picture of the entire sun made in this way with the H line of calcium.

Hale has constructed several of these instruments at Mount Wilson, and has designed the tower telescope, shown in Plate XXIII, for use with one of them. Here the objective, 12 inches in diameter, is placed at the top of the steel tower, 150 feet high, and a coelostat in the small dome at the top arranged to reflect the sunlight into it and down the inside of the tower. An image of the sun 16 inches in diameter is

formed at the base of the tower in the observing room. Below the tower is a pit 80 feet deep, at the bottom of which is placed the prism which refracts the light back to the observing room where the spectrum is formed, and exposures can be made. The great advantage of such an instrument is that it gets above most of the atmospheric disturbances near the surface of the earth.

Thus we have considered some of the most important applications of photography to astronomy, but there are still others, such as the determinations of stellar magnitude and the study of eclipses. Indeed, there is scarcely a branch of astronomy in which photography has not found successful application, and to fully consider them we would have to go over the entire field of astronomy. As time goes on and technical improvements are made—improvements that might seem just as impossible to us as our ordinary apparatus would have seemed a century ago—it is certain that astronomy will depend more and more on it and our debt to Daguerre and the other pioneers will become increasingly great.

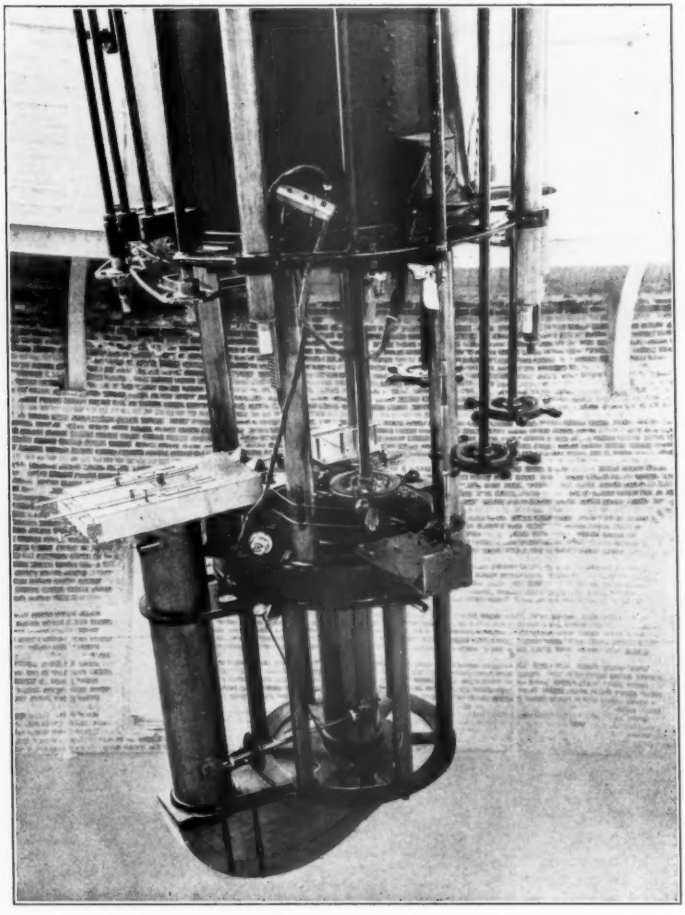
RELATIVITY SINCE 1922.

By W. H. PICKERING.

A very important event in the history of this interesting theory has now taken place—the confirmation at last of one of the three tests suggested by Einstein. The photographic results obtained by the Lick Observatory party in Australia appear to leave no doubt that a star's rays, when passing near the sun, experience twice the deflection that we should expect under the Newtonian law of gravitation. Not withstanding this fact, we understand that some of the French astronomers are still unconvinced, and are preparing to repeat the experiment at this coming eclipse. Should they succeed in confirming the result, the whole scientific world, ever skeptical as to new theories, should certainly accept that fact as settled.

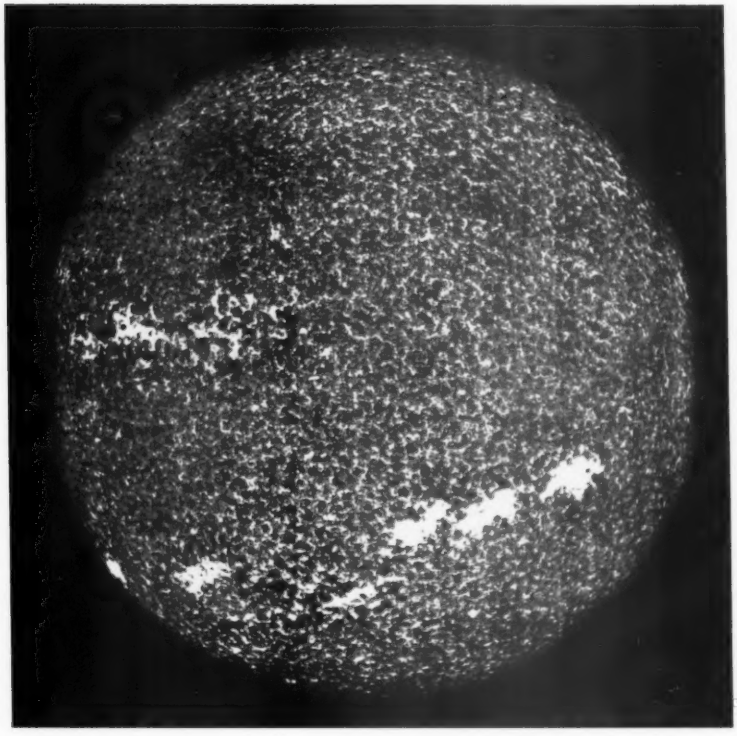
As stated in a previous paper the results of the eclipse of 1919, although highly lauded at the time, carried but little conviction in favor of Relativity to conservative scientific opinion. Firstly, because two-thirds of the photographs were rejected as inferior, and it so chanced that these particular plates all supported the Newtonian theory, while the remaining ones which were accepted, supported that of Einstein. Secondly, because no precautions had been taken to determine the

PLATE XXVII



THE RUMFORD SPECTROHELIOGRAPH
attached to the 40-inch Yerkes Telescope.
From Publications of the Yerkes Observatory Vol. III, Part I.

PLATE XXVIII



THE SUN,
photographed in the light of the H (Calcium) line, showing large and small areas of Calcium Flocculi.

From Publications of the Yerkes Observatory Vol. III, Part I.

scale of the photographs, the instruments employed being of a kind peculiarly liable to a change of scale.

The theory of Relativity has proved itself very acceptable to the physicists, notably in connecting the mass of an electron with its velocity, and in one or two minor matters. It now appears from the Australian results that Einstein is at all events in part correct in his views. But where shall we draw the line? To the astronomer the theory as it stands, or should we be more accurate to say the hypothesis as it stands, is still in a distinctly doubtful position. Regarding the advance of the perihelion of Mercury, of which at first we heard so much, and which really first brought the theory into general notice, if we may paraphrase a well known line, "the theory doth explain too much."

According to Leverrier, and still more accurately to Newcomb, the observed advance of the perihelion amounts to $41''.6 \pm 1''.4$. This result excludes all known planetary perturbations, but includes the advance caused by the spheroidal shape of the sun. This shape cannot be determined by observation, but knowing the sun's rate of rotation it can be computed approximately, and we find that the effect produced by it amounts to $3''.5$. Correcting by this figure the advance that remains to be accounted for is $38''.1$. According to the theory of Relativity the advance should be $42''.9$. It is therefore $4''.8$ or 12.6 per cent too large! Had this correction not been overlooked, it is quite possible that we should have heard less of the theory at the present day.

According to Einstein himself the theory should not be accepted, unless we find that the solar spectrum lines are displaced by a certain amount towards the red end of the spectrum. Several independent observers have found a displacement of just the proper amount. Thus we are informed by Perot, that the displacement is fully confirmed if we assume a *downward* movement in the solar atmosphere and a negative pressure shift of some of the spectrum lines. To this statement Dr. Birge also agrees, provided we assume an *upward* movement in the solar atmosphere and no pressure shift of the lines. In this Grebe and Bachem further concur, provided we assume no radial movement in the solar atmosphere, and no pressure shift in the lines, if we will but apply however a correction for their unsymmetrical density. (Annual Report of the Director of the Mount Wilson Observatory, 1921, p. 242.)

As St. John remarks, these results "fail to carry conviction". Evershed who has paid especial attention to this matter has as yet made no final report, while St. John who has undoubtedly the best instrumental equipment of all the investigators finds, according to the last Report giving definite results, that of 1920, p. 226, a mean shift in the right direction amounting to 0.0013 Angströms for three magnesium lines, or of about one-eighth of the amount required by Einstein. This is in

addition to the unfavorable evidence based on the cyanogen lines, given in the Report for 1917.

Finally the very foundation of Relativity is the generally accepted theory of Aberration. But if Airy's observations made at Greenwich with the water telescope are correct, this theory is certainly wrong (Pop. Ast. 1922. **30**, 340). The constant of aberration is 22".5. With the water telescope the value should be 30".0, but it was found to give the same result as an ordinary instrument (Journ. Brit. Astron. Assoc. 1919, **30**, 61). We trust that Airy's meridian observations were not in error by 7".5! Such is not the reputation of Greenwich.

We have learned with pleasure that Michelson is preparing to further settle the question experimentally on Mount Wilson, as to whether the accepted theory of Aberration is correct. Until this is done, we may say that Relativity has been confirmed by one experimental test, but has been rejected by three others. When facts fail to agree with theory, shall we say "so much the worse for the facts", or "so much the worse for the theory"?

Mandeville, Jamaica, B. W. I.
May 12, 1923.

THE ECLIPSE OF SEPTEMBER 10, 1923.

By E. A. FATH

An eclipse of the sun is caused by the moon coming between us and the sun as shown in Fig. 1. Since the moon's distance from the earth varies the apex of the shadow sometimes does not quite reach the earth's surface and in consequence the sun's disk is not entirely covered. When the moon is comparatively near, the shadow actually touches the earth and those situated within the shadow have the pleasure of witnessing one of the most impressive of natural phenomena.

As the moon moves eastward around the earth at the time of the eclipse, the tip of the shadow traces the eclipse path across the earth's surface. The path of the coming eclipse is shown in Fig. 1. It starts in the north Pacific just off the coast of Asia at a point a little beyond the left end as shown in the figure. After crossing the entire Pacific it first strikes land on the California coast, then crosses Mexico and ends off the northern coast of South America.

Figs. 2 and 3 show the path of the shadow on a larger scale. The first of these was plotted from the information given in the *American*

Ephemeris and the second is a tracing of a part of a map printed by the Mexican government and sent out by the observatory at Tacubaya.

The only United States territory which is crossed by the central line of the shadow path is San Clemente island off the California coast. As the island is practically uninhabited and living conditions therefore difficult, it has not yet, so far as known, been chosen by anyone as a location for an eclipse station. Totality will last $3^{m}\ 36^{s}$ at San Clemente and it would therefore be a very desirable location if living conditions could be made tolerable.

The eclipse of next September is of particular interest to observers of this country as it is the only one which will occur under weather conditions favorable to good observations on U. S. territory until 1945. There will be an eclipse in January, 1925, visible in the northeastern

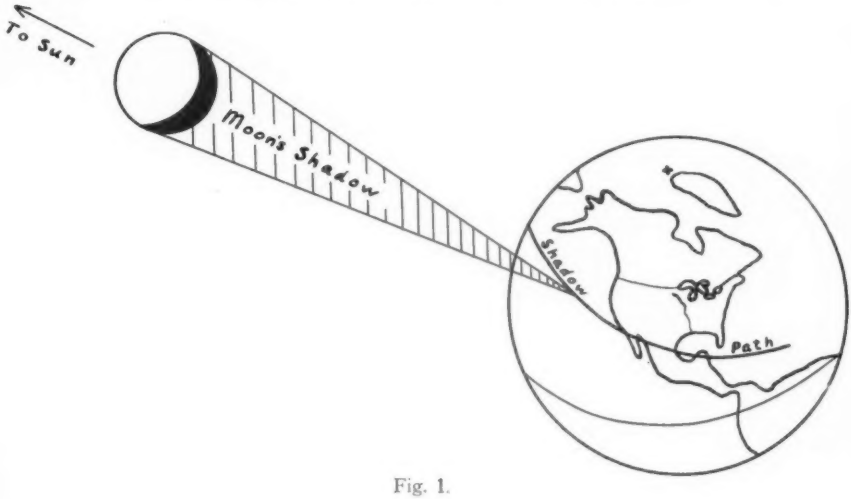


Fig. 1.

part of the country, but it will occur in the early morning under winter conditions so that prospects for good observing conditions are not particularly good.

In the report of the Eclipse Committee of the American Astronomical Society, published in the April number of POPULAR ASTRONOMY, it will be noted that Avalon on Catalina Island, San Diego, Tiajuana in Lower California and Cuencame in central Mexico, are almost certain to have clear weather at the time of the eclipse while a number of other stations are almost as desirable.

The eclipse will occur about 1 P. M., Pacific Standard Time, at Avalon and San Diego. The Greenwich Mean Time for stations in Mexico may be read from Fig. 3.

There are still a number of unsolved eclipse problems which deserve

the most careful attention. The first of these in importance is the nature of the solar corona. While the corona has been observed for many years with a view to solving its mysteries, there is still but little that is known about it. We know that a portion of its light is polarized, that its spectrum consists in part of reflected phoospheric light and in part of bright lines, that it rotates in the same direction as the sun and that its general outline changes with the sun-spot curve. We know practically nothing of the forces which determine the direction of its streamers; nothing of the real nature of the substances compos-

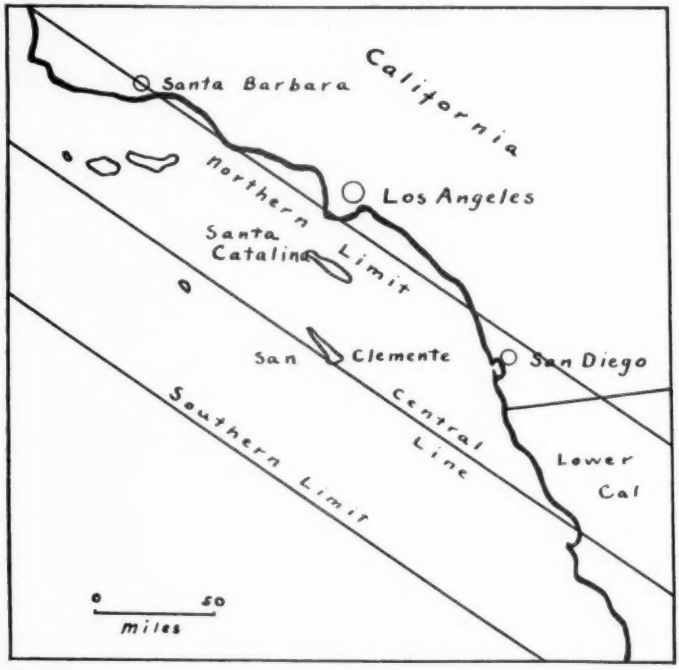


Fig. 2.
Path of Total Solar Eclipse Sept. 10, 1923, off the Coast of Southern California.

ing it, their source, or their motion in the streamers; nothing about its rotation except direction. While it seems reasonable to suppose that other stars than our sun have similar coronal appendages, yet we cannot be sure that it is not unique among the stars like Saturn's ring is among the planets.

Another problem which still deserves some attention is the "flash" spectrum. The Mt. Wilson observers some years ago succeeded in

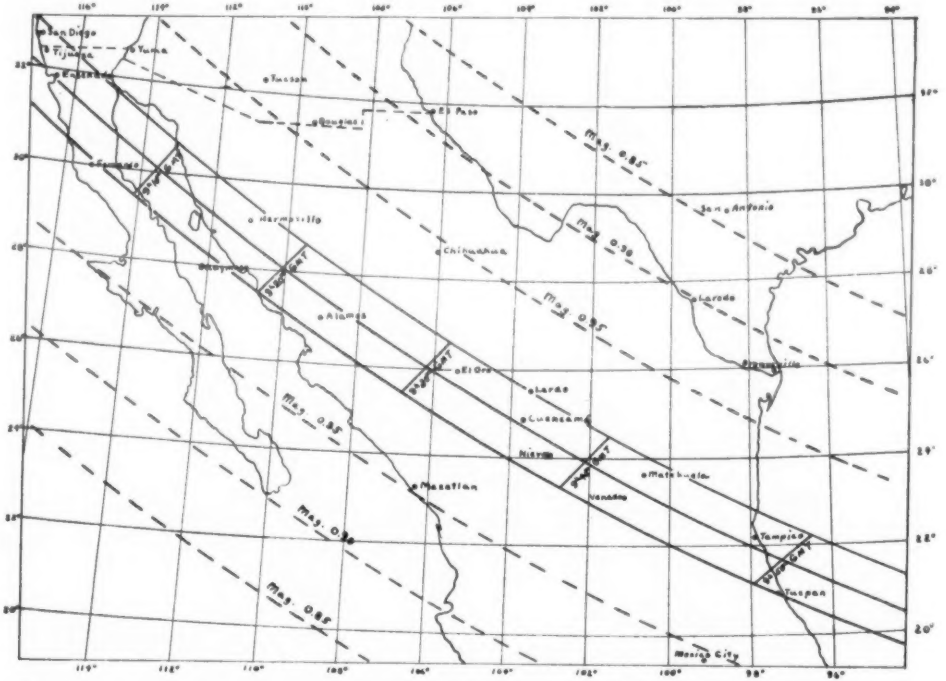


Fig. 3. Diagram of the Path of the Total Solar Eclipse, Sept. 10, 1923, across Mexico. The smooth curved lines indicate the path of totality, the broken lines show the percentage of sun's disc covered in adjacent regions.

obtaining the "flash" spectrum without an eclipse but it would seem desirable to secure some large-scale spectra under eclipse conditions.

Another problem which deserves some attention is that of the "shadow bands." While it seems almost certain that this phenomenon has its origin in our own atmosphere, nevertheless no really satisfactory evidence has been obtained to prove this.

The results of the Lick Observatory and Canadian expeditions to Australia last year appear to have established the Einstein theory of the deflection of a ray of light passing through the gravitational field of the sun, yet it would not be without value to continue observations of this character so long as stars of sufficient brightness are to be found in the eclipse field.

There is also the question of the existence of unknown planets near the sun. The fruitless search of many years makes it reasonably certain that no large planets are to be found, but this seems no reason why smaller ones may not exist.

Observations of contact times at places whose latitudes and longitudes are accurately known will be of value.

Eclipse Expeditions and Stations.

From letters and other sources we have the following information on various expeditions and the stations they will occupy. The stations will be listed in the order of time of totality.

Catalina Island. Yerkes Observatory with extensive equipment.

Washburn Observatory, University of Wisconsin. To measure the brightness of the corona with photo-electric cell.

Goodsell Observatory of Carleton College. To photograph corona and star field around the sun with 8-inch lens and to secure "flash" spectrum with grating.

San Diego and vicinity. Mt. Wilson Observatory. One station at Point Loma to photograph corona and star field around sun, to measure intensity of coronal radiation with thermo-couples, to photograph spectrum of corona and chromosphere with slit spectrographs, to use interferometer to determine wave-length of green coronal line and rotation period of corona. Another station at Lakeside, near northern limit of eclipse path, will also be occupied to photograph "flash" spectrum with concave grating.

Leander McCormick Observatory. Two stations will be occupied, one at Point Loma and another near northern limit of shadow path. At both stations concave gratings will be used to photograph the "flash" spectrum.

Ensenada. Lick Observatory with extensive equipment.

Students' Observatory, University of California. To study polarization of the coronal light. This expedition will be affiliated with the Lick expedition.

Hermosillo. Steward Observatory, University of Arizona, will occupy a station near the central line south of Hermosillo. The equipment will consist of a 5-inch lens of 39 feet focus and two reflectors of 2 and 5.5 feet focus respectively.

Cuencame. This station will be used by the expedition from the Sproul Observatory of Swarthmore College to photograph corona with lenses of 65 feet, 104 inches and 38 inches respectively; to secure plates to test Einstein effect; to photograph "flash" spectrum; to test corona for rotation with interferometer.

Mexican National Observatory. This observatory will send out two expeditions, the main one to occupy a station near Cuencame and the other a station at Berrendo, a point on the central line about half-way between Cuencame and Tampico. Photographs of the corona, contact times, moving pictures and sketches by an artist comprise the program.

University of Toronto. To study the polarization of the light of the corona and to obtain spectrograms.

We desire to call attention to the letter from Dr. Campbell, chairman of the eclipse committee, on page 419. The kindness of the Mexican government to prospective observers in that country is worthy of the highest commendation.

ANTARES.

Again, Antares rises weird and red,
Like glowing eye in gleaming Scorpio,
When grand Arcturus glitters overhead,
And golden-hued Capella glimmers low.

Through timeless space Antares hurls his rays,
And shines, afar, on star and satellite,
On other worlds, perhaps, whose dwellers gaze
At suns and constellations of their night.

Like titan star upon a sparkling throne,
Antares reigns, unrivalled and alone!

41 Arlington St., Newton, Mass. CHARLES NEVERS HOLMES.

A SIMPLE ECLIPSE OBSERVATION BEARING ON RELATIVITY.

By WILLIAM H. PICKERING.

Recent total eclipses have been observed with such elaborate and expensive apparatus that the average astronomer, while anxious to see an eclipse for his own sake, and to get some photographs of it, yet feels that the value of any scientific results that he might be able to attain would hardly justify the expense of the expedition, or even the expense of transportation of his instruments. This last objection will not apply to the experiment here suggested. It is nevertheless believed that any results secured might be of distinct advantage to science. Before describing the apparatus however, we will first discuss the information that we desire to obtain, and explain its bearing on our present knowledge.

In my paper on "Relativity since 1922" it was shown that while the Lick observations in Australia apparently fully confirmed the view that for minute bodies like the ether waves, or the electrons, the mass was dependent merely on the velocity, yet for more massive bodies like the planet Mercury, our formula gave too large a result. The same is true for ether waves approaching us directly from the sun; the formulae of relativity fail to conform with the facts, and give an entirely erroneous value, which in both cases is too large.

In the paper above mentioned, the error in the case of the perihelion of Mercury was found to be 12.6 per cent. But there is another fact not mentioned there which would unquestionably tend to increase the error still further, possibly even to a hundred per cent, in other words to show not merely that the formula is inaccurate, but that there is no truth in it whatever as applied to Mercury. Dr. Poor in fact believes that such is the case (*Scientific American*, 1921, **3**, 484). Following other computers, he suggests that the whole of the required advance may be accounted for by the attraction of a dense ring of meteoric matter surrounding the sun. He suggests in fact three rings, a dense one lying at a distance of 0.5 from the sun's center, or 4,000,000 miles from its surface, and two others much less dense, one of them extending out beyond the orbit of the earth.

The chief objection to this hypothesis is that any substance lying so near the sun as he suggests would certainly be vaporized, and repelled by the repulsion of light. If it were not repelled, its spectrum would be visible as a series of bright lines surrounding the chromosphere, at the time of a total eclipse. By means of an objective prism the spec-

trum of the corona as far as the green has been traced to a height of 1,000,000 miles above the sun's surface, but no bright lines were found in it. The coronal line disappears at a much less elevation. Long exposure photographs indicate that during an eclipse, beyond 2,000,000 miles from the limb, the light of our sky is practically uniform for a distance of at least 10°. The added light within the 2,000,000 miles is doubtless due to a faint extension of the corona.

Although therefore a ring of the dimensions suggested appears to be improbable, yet a ring of some sort undoubtedly exists, and the effect that it will produce on the orbit of Mercury depends merely on its location and mass. The required mass can be determined by computation, the actual brightness by observation during a total eclipse, and its surface can be computed by comparison with the light of our moon. Given the mass and the surface we can compute the average size of the component meteors. We can then see if our result appears plausible. If not, then the Relativity formula must account for the greater part of the advance of the perihelion.

A preliminary investigation showed at once that the meteors would be large, so the question at once arises, how large are any bodies that are likely to exist in great numbers in the vicinity of Mercury, or between it and the sun. It is known that the average diameter of a meteor of the 3d magnitude is about 2 millimeters, or 1/12 of an inch (Popular Astronomy, 1919, **27**, 203). It might seem at first sight that this is about the size that we should expect to find near the sun. We must remember however that most of this matter has been exposed to an intense light pressure for many millions of years, and has therefore long ago been swept out of this portion of the solar system.

From another point of view the resemblance between comets and asteroids is marked. Thus the short period comet Neujmin, 1913, *c*, was practically entirely nucleus. For only a brief interval did photography show a very faint coma. None was certainly visible in the telescope, although a slight haziness was once suspected by Barnard. This is one of Saturn's comets, revolving in a period of 18 years. Up to 1915 four asteroids were known whose eccentricities ranged as high as from 0.41 to 0.54. Probably more have since been discovered. Four comets, namely Holmes, Temple$_1$, Brooks, and 1890 VII, have eccentricities ranging as low as from 0.41 to 0.47. Had either of these been seen without a coma, like Neujmin's, since their periods are similar to those of the asteroids, it would certainly have been classed as one of those bodies. Possibly some of the more eccentric asteroids may have comas when near perihelion.

The periodic comets, as they constantly return to the sun, continue to lose their comas. One of the more striking ones is Encke's comet, which was first discovered in 1786. It was visible to the naked eye in 1795, 1805, 1829, 1848, 1858, 1871, and 1881, usually at intervals of

about ten and thirteen years, when it was most favorably situated for observation. In 1805 and 1848 it had a visual tail over a degree in length. During the past forty years on the other hand, it has never been visible without instrumental aid, although in 1914 it could be seen with an opera glass.

Elliptical orbits even in a slightly resisting medium tend in time to become circular. If a comet having as large a nucleus as Neujmin's had been captured once every million years by Jupiter, since the surface of the earth solidified, several thousand million years ago, and had since lost its coma and part of its eccentricity, there would now be several times as many asteroids belonging to our system as have yet been discovered. An asteroid indeed may be described as a nucleus bearing comet of small eccentricity that has already lost its coma. The majority of the known asteroids are believed to be at least ten miles in diameter, though doubtless there are many smaller ones yet undiscovered. If the nuclei of the comets are composed of single pieces, some of them must be fully as large as that.

While the mass of Mercury is small, yet many more comets pass near it than approach any other planet. Encke's comet is one of these, and since its aphelion lies far inside the orbit of Jupiter, it is quite possible that this comet properly belongs to Mercury. During the enormous period of time that has elapsed since Mercury came into existence, there has been time enough for it to have captured many comets, and for their comas to have vanished completely. Once captured by Mercury the larger portions of the comet would rarely escape, but would revolve forever in small orbits about the sun.

Assuming then that a ring of small asteroids captured by Mercury, and formed from cometary debris, lies within Mercury's orbit, as indeed must almost necessarily be the case, we must next attempt to determine its dimensions. The mean distances of most of the known asteroids lie between 2.2 and 3.2, that of Jupiter being 5.2. The same proportions should be maintained for Mercury, in order to retain the same relations of their periods. The asteroids would then lie between 15,000,000 and 22,000,000 miles from the sun. If they were condensed into a single planet at their mean distance, 0.20, or 18,500,000 miles, they would have to possess a mass equal to ¼ that of Mercury in order to produce the observed advance of its perihelion. We shall assume that the whole group of asteroids possesses this mass. Leverrier found that at a distance of 0.12 the mass of Vulcan would have to be 2.67 times that of Mercury in order to produce the observed perturbation, but at a distance of 0.27 it would have to be only 0.17 as great, in order to produce the same effect.

In his concluding sentences Dr. Poor, in the above mentioned article, refers to the desirability of determining the actual distribution and density of matter in the vicinity of the sun. He says "In 1908-10, be-

fore Einstein had developed his astronomical theories, I called attention to the desirability of doing this; but the astronomical world could not see the need of the investigation and it was never made." If Dr. Poor had chanced to turn to the Harvard Annals **32**, 98 he would have found a statement that the intrinsic actinic brightness of the Oceanus Procellarum on the moon, as determined on two evenings, ranged from 1.14 to 1.29 units, the unit being there described. On p. 103 the statement is made that the brightness of the full moon ranges from 1180 to 2140 thousandth units. We may therefore take the brightness of Mare Tranquilitatis, the darkest of the lunar seas, at 1.20 units at the time of full moon, and the brighter areas at 2.14. On p. 105 the average brightness of the full moon is given at 1.66 units, and in the same table the brightness of the sky surrounding the corona, as measured during the total solar eclipse of 1886, as 0.0007 units. The brightness of the sky in front of the moon was found to be zero. It therefore appears that the light surrounding the sun and the corona came from a region beyond the moon, and not from our own illumined atmosphere. As these measures were made and published some twenty years before Dr. Poor made his criticism of the supineness of the astronomical world, it is perhaps quite excusable that he should have overlooked them.

These statements as published in the Annals are of course only bare facts. Now as to their application. If the meteoric matter within the orbit of Mercury is black, and therefore similar in reflective power to the Mare Tranquilitatis, it makes no difference whether we compare them visually or photographically, as we should obtain the same result. According to these measures Tranquilitatis was 1700 times as bright as the matter illumined by the sun, and lying beyond the moon. Now it is clear that no appreciable light can be reflected from those meteors lying between us and the sun. Therefore the light must have come from a section of this assumed meteoric ring lying beyond the sun, and extending from fifteen to twenty-two million miles away from it. This section which is seven million miles deep shines then with a light which is intrinsically 1/1700 as bright as Mare Tranquilitatis.

We now propose to find out the average size of the meteors composing this ring. It is obvious that an approximate solution is all that the accuracy of the observations will bear. Having determined their size, we shall then consider if the result seems plausible, and may therefore furnish a probable explanation of the advance of the perihelion of the orbit of Mercury. We must expect to find a very great range of sizes, and the average neither very small nor very large. Our ideas of what is plausible are clearly very vague, and this indeed must be the chief criticism of our result. We can however fix a maximum size, by assuming that if brighter than the 9.0

magnitude those asteroids would have been already discovered during some solar eclipse by means of photography.

Let us take the diameter of Mercury as 3000 miles, and its mean stellar magnitude when in opposition at —1.0. If placed as near the sun as the average asteroid composing the ring, its magnitude would be —2.4. An object having the same albedo, and 11.4 magnitude fainter than Mercury, would have 1/190 of its diameter, or 16 miles. Any asteroid at mean distance from the sun whose diameter exceeded this figure might therefore have been discovered by photography. We cannot place any lower limit to the size of these asteroids, and it is very probable that there may be a certain amount of meteoric dust of recent accumulation in this region. The great bulk of it however must have been eliminated millions of years ago.

In order to determine their probable size, we shall begin by assuming that the cross section of the ring of meteoric matter or asteroids is circular, and that the ring is therefore what is technically known as a torus or anchor ring. The meteors we shall assume to be spherical in shape. In our investigation we shall for convenience employ the meter and metric ton as units. The mean radius of the ring, 18,500,000 miles, expressed in metric units is 3.0×10^{10}, and the radius of its cross section, 3,500,000 miles, is 5.6×10^{9} meters. Its volume V is therefore 1.9×10^{31}. The mean distance of the full moon from the sun is 93,100,000 miles, equal to 15×10^{10} meters. The meteor at mean distance is therefore illumined by 25 times the amount of light received by the full moon. The circular area presented to us on the section of the ring at mean distance from the sun, and beyond it, which will give the observed brightness, must therefore have 25×1700 times the projected area of the meteor. The radius of the meteor we will call r, its projected area πr^2 and the circular area on the ring $42{,}500\,\pi r^2$. The volume v of the cylinder containing one meteor will equal this area times the thickness of the ring, or $4.2\,\pi r^2 \times 10^4 \times 1.1 \times 10^{10} = 1.4 \times 10^{15} r^2$. The volume of the meteor will be $4\pi r^3/3$, and if of iron its mass m, which will be identical with that of the cylinder, will be $33\,r^3$.

The mass of the earth we shall take as 6×10^{21} metric tons. The mass of Mercury is 0.055 times that of the earth, and the mass of the whole ring of meteors M we shall take as one quarter of that, as stated above, or 8.2×10^{19} tons. We then have $m\,V/v = M$, which equation by substitution of the quantities in the previous paragraph at once gives us the radius of the spherical meteor r, as 180 meters. Reducing this back to ordinary units gives us for its diameter 1200 feet. The average distance between the meteors will be about 5,000 miles. In so crowded a region the smaller masses would gradually be absorbed by the larger ones. Doubtless some will be appreciably larger than this, perhaps several miles in diameter and many very much smaller.

If any are smaller, some must be larger, though not necessarily very much so. These figures will however give us a general idea of what to expect, and also a definite value for the density per cubic mile of material. In terms of the density of the sun this is 6.3×10^{-13}.

While we have no means of checking these results, there is certainly nothing impossible, and perhaps not even improbable in them. Unless the hypothesis of Relativity can be better substantiated in the future in some way than it is at present, and its theoretical conclusions brought into better agreement with the observed facts, the above explanation seems to give at least a plausible way of accounting for the observed advance of the perihelion of Mercury. If it accounts for even an appreciable portion of it, the Relativity hypothesis is further invalidated.

Proposed Apparatus.

Now regarding the proposed eclipse observations, since those already described were made nearly forty years ago, were only a side product of the expedition, and have not as far as I am aware been repeated by anyone else since that time, it would appear to be well to repeat them now, with improved and simplified apparatus. It is proposed that a camera be used without any lens, but in its place a simple round aperture, which might be cut out of cardboard, whose diameter is one-eighth of its distance from the plate. In front of the plate and in contact with it is placed a piece of perforated brass containing numerous minute holes, such as are used for making strainers. Several of these cameras may be mounted on a wooden stand, in such a manner that they can be pointed by means of a sight at an angle of 10° from the sun, one in the direction of the ecliptic, one at right angles to it, etc.

It is believed that an exposure of 20 seconds would be about right with a fairly quick plate, but since the sky surrounding the corona is approximately as bright as the night sky near Polaris three minutes after it first becomes visible in the evening, it is easy to test the matter before the eclipse (H. A. **18**, 105). A similar camera furnished with an aperture whose diameter is one-fortieth as large may be later attached to an equatorial clock-driven telescope, and pointed on the full moon. The exposure should be the same as that given to the sky during the eclipse, and the aperture varied if necessary. If the lunar exposure is also made through perforated brass, then by turning the two developed plates film to film it is easy to compare their density. The reason that the exposures should be of the same duration is in order to eliminate the time correction of the plate (H. A. **32**, 20). For slow plates giving great contrast the time correction is very considerable. It is believed that photographs taken with such simple apparatus, giving measures of the brightness of the sky around the eclipsed sun, would

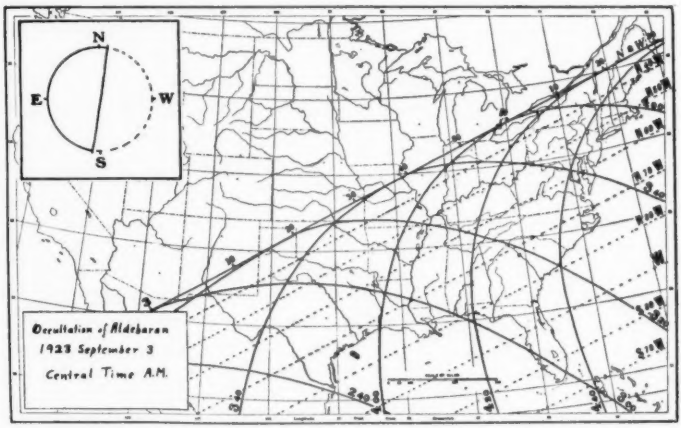
have a very considerable scientific interest in connection with the present discussion of the truth of the hypothesis of Relativity.

Mandeville, Jamaica, B. W. I.
May 24, 1923.

THE OCCULTATION OF ALDEBARAN, 1923, SEPTEMBER 3.

By WILLIAM F. RIGGE.

The occultation of Aldebaran on next September 3 will be visible only to the southeastern half of the United States. It will take place in the early morning, as the annexed map shows. The beginning or immersion, which is given by the eastern or right parts of the time curves, will occur between about 2:40 and 4:00 A. M., Central Standard Time, and the end or emersion, given by the western or left parts of the time curves, from about 3:40 to 4:40 A. M. The Limit Line needs no explanation. The numbers on it denote the times of the grazing contacts from 3:00 to 4:30.



The moon will be only a few hours (6:47 A. M.) from Last Quarter, so that the terminator is practically a straight line, as the insert shows. The dotted lines on the map give the position angles on the dark or western limb of the moon at which the star will reappear. As the northern end of the terminator is 8° 36′ to the west or right of the moon's north point N, it may be convenient to measure the position angles from this point. The grazing contact on the limit line will take place almost exactly on the northern end of the moon's terminator.

THE OCCULTATION OF SATURN, 1923, SEPTEMBER 12.

By WILLIAM F. RIGGE.

The occultation of Saturn of next September 12 is in several ways probably the most ideal one that an amateur would like to arrange for himself. The object eclipsed by the moon is of the 1.0 magnitude, in fact, it is a planet, Saturn. The moon is a very slender crescent, only 2.1 days old. And the event occurs at a most convenient hour of the evening. However, as nothing sublunary is perfect in every way, the drawbacks are that the occultation will not be visible as such to the eastern states, only partially so in the Mississippi Valley, and in the western states daylight or twilight and the low altitude of the moon may rob the phenomenon of much, if not all, of its impressiveness.

The accompanying maps give all the necessary particulars. In both the full lines, marked from 6:40 to 7:40 and from 7:40 to 8:10, give the Central times for every ten minutes of the immersion, or disap-

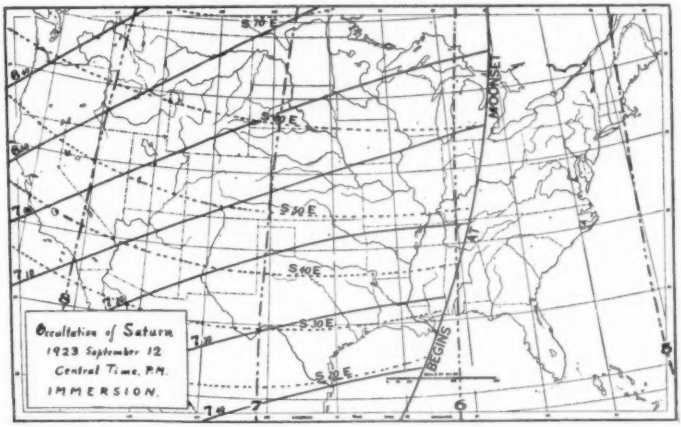


Fig. 1.

pearance of Saturn behind the eastern dark limb of the moon, and of the emersion, or its reappearance at the bright west side of the crescent, from which by estimation we may find the nearest single minute. The dotted lines from S 20 E to S 70 E and from S 70 W to N 80 W show the position angles on the moon's disk at which the immersion and emersion will take place.

The moon's phase is shown in the insert in Fig. 2, NSEW being its cardinal points. As these will appear to be turned considerably in a clockwise direction, to an extent that depends upon the observer's latitude and longitude, the position angles given may be corrected to read from the moon's cusps, when we know that the north cusp is 16° 35′ to the left or east of its north point N.

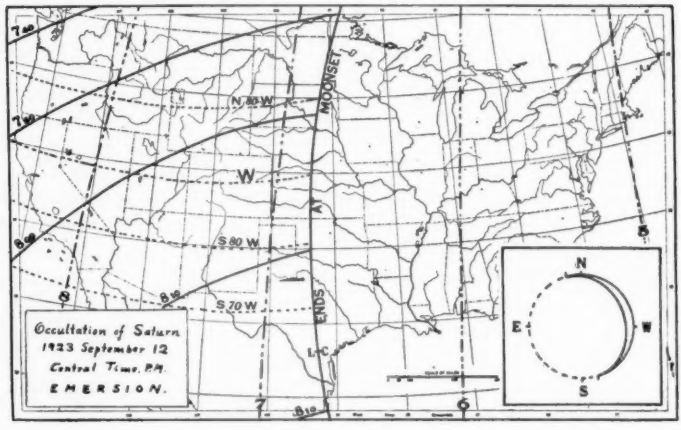


Fig. 2.

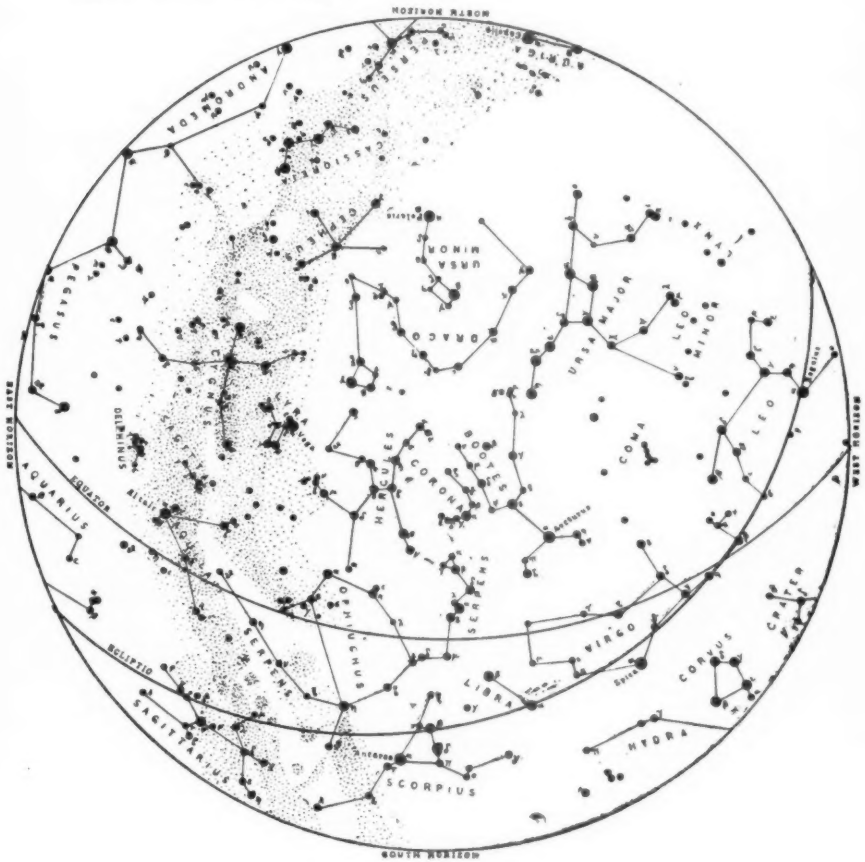
The curve "Begins at Moonset" means that Saturn will be occulted at the moment the moon sets, and similarly the curve "Ends at Moonset" that the planet will reappear when the moon sets. Between these curves the moon will set with Saturn hidden behind it. The places west of both curves will see the whole occultation, although as said, daylight and twilight may interfere considerably, while to those east of them the occultation will not be visible as such at all and there will be only a very close approach.

The point LC on Fig. 2 means "Last Contact." It denotes the place on earth that will be the very last to see Saturn emerge from behind the moon at 8:14. The lines marked 5, 6, 7, 8, at the bottom, indicate the full hours of sunset, Central Standard Time, from which the visibility of the occultation may be gaged.

It is also to be noted that as planets present sensible disks and are not points like stars, their occultations cannot be sudden. In this instance it will take the moon 24 seconds to cover and uncover the ball of Saturn, and one minute exactly to run the length of the major axis of its ring. The moon's semidiameter 16° 30″ is 140 times Saturn's, which is 7″.06.

PLANET NOTES FOR JULY AND AUGUST.

The *sun's* motion during these two months will take it from $6^h\,31^m$ to $10^h\,38^m$ and from $+23^\circ\,10'$ to $+8^\circ\,56'$. Its path for this period starts in Gemini, passes through Cancer and ends in Leo. It will pass very close to the bright star Regulus near the end of August.



THE CONSTELLATIONS AT 9:00 P. M. JULY 1.

The phases of the *moon* will occur as follows:

Last Quarter	July 5 at	8 P. M.	C. S. T.
New Moon	13 "	7 P. M.	"
First Quarter	20 "	8 P. M.	"
Full Moon	27 "	5 P. M.	"

Last Quarter	Aug. 4 at 1 P. M.	C. S. T.
New Moon	12 " 5 A. M.	"
First Quarter	18 " 12 P. M.	"
Full Moon	26 " 4 A. M.	"

Mercury will be moving eastward throughout these months. It will pass the sun on the opposite side from the earth on July 22. At the end of August it will be very near a point of greatest eastern elongation. It will be about ten degrees south of the sun.

Venus will be too near the sun to be seen during this period. It will cross the meridian at 10:41 on July 1 and at 11:53 on August 31.

Earth will be at its farthest point from the sun for the year on July 5 at 6 P. M. C. S. T.

Mars will be in conjunction with the sun on August 8. It will therefore be invisible during this period. At the time of conjunction it will be about 250 million miles from the earth.

Jupiter will be in quadrature with the sun, 90° east, on August 3. On this date it will be in the constellation Libra.

Saturn will be in quadrature with the sun, 90° east, on July 6. It will be in the constellation Virgo, a short distance northwest of Spica.

Uranus will be in position for observation during this period. At the end of August it will be on the meridian at midnight, at a point between five and six degrees south of the equator.

Neptune will be obscured by the sun during this period. It will be in conjunction with the sun on August 11.

Occultations Visible at Washington.

[*From the American Ephemeris.*]

Date 1923	Star's Name	Magnitude	IMMERSION. Washington M.T.	IMMERSION. Angle from N	EMERSION. Washington M.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
July 2	213 B. Aquarii	6.5	10 20	44	11 14	286	0 54
2	λ Aquarii	3.8	16 35	79	17 56	227	1 22
7	85 Ceti	6.3	15 8	37	16 8	279	1 0
9	γ Tauri	3.9	15 6	90	16 4	238	0 58
10	α Tauri (*Aldebar.*)	1.1	1 28	91	2 36	263	1 8
18	27 B. Virginis	6.5	7 50	187	8 8	220	0 19
19	38 Virginis	6.1	7 16	77	8 14	330	0 58
22	η Librae	5.5	9 4	128	10 15	259	1 11
23	24 Scorpii	5.0	8 3	78	9 19	305	1 16
26	267 B. Capricorni	5.8	6 54	68	7 57	291	1 4
27	47 B. Capricorni	6.2	8 4	129	8 53	218	0 49
27	61 B. Capricorni	5.9	10 53	78	12 19	254	1 25
30	φ Aquarii	4.4	10 45	44	11 53	275	1 8
Aug. 9	162 B. Gemin.	5.7	14 51	93	15 43	266	0 52
22	*d* Sagitarii	5.0	6 9	150	6 48	211	0 39
26	81 Aquarii	6.4	13 59	87	15 13	220	1 14
26	82 Aquarii	6.4	15 27	8	16 8	302	0 41
28	10 Ceti	6.4	7 51	19	8 27	304	0 36
30	39 B. Arietis	6.5	11 7	60	12 19	253	1 12
30	64 Ceti	5.8	16 14	43	17 37	269	1 23

Phenomena of Jupiter's Satellites.

VISIBLE AT WASHINGTON.

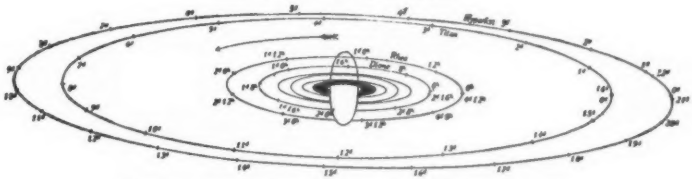
[From the *American Ephemeris.*]

CENTRAL STANDARD TIME. NOON = 0h

1923		h	m			1923		h	m		
July	1	7	54	I	Ec. R.	July	16	7	49	I	Tr. E.
		7	54	II	Tr. I.			9	2	I	Sh. E.
		10	5	II	Sh. I.		17	7	45	II	Oc. D.
		10	14	II	Tr. E.			10	9	II	Oc. R.
	3	7	24	II	Ec. R.			10	18	II	Ec. D.
	5	9	46	III	Ec. D.		22	10	13	I	Oc. D.
	7	9	20	I	Tr. I.		23	7	33	I	Tr. I.
		10	29	I	Sh. I.			7	42	III	Sh. I.
	8	9	49	I	Ec. R.			8	48	I	Sh. I.
		10	20	II	Tr. I.			9	28	III	Sh. E.
	9	7	7	I	Sh. E.			9	42	I	Tr. E.
	10	7	37	II	Oc. R.		24	8	7	I	Ec. R.
		7	41	II	Ec. D.		26	6	58	II	Tr. E.
		10	1	II	Ec. R.			7	8	II	Sh. I.
	12	8	49	III	Oc. D.			9	26	II	Sh. E.
		10	40	III	Oc. R.		30	8	23	III	Tr. E.
	15	8	21	I	Oc. D.			9	27	I	Tr. I.
Aug.	7	7	21	I	Sh. E.	Aug.	15	7	48	I	Tr. I.
	2	7	10	II	Tr. I.		16	8	20	I	Ec. R.
		9	32	II	Tr. E.		17	6	33	III	Oc. R.
		9	44	II	Sh. I.		18	7	31	II	Oc. D.
	4	7	10	II	Ec. R.		20	6	31	II	Sh. E.
	7	8	30	I	Oc. D.		23	6	52	I	Oc. D.
	8	7	8	I	Sh. I.		24	6	24	I	Tr. E.
		8	1	I	Tr. E.			7	35	I	Sh. E.
		9	16	I	Sh. E.		27	6	47	II	Tr. E.
	10	7	30	III	Ec. R.			6	49	II	Sh. I.
	11	7	16	II	Oc. R.		31	6	12	I	Tr. I.
		7	27	II	Ec. D.			7	21	I	Sh. I.

NOTE:—I. denotes ingress; E., egress; D., disappearance; R., reappearance; Ec., eclipse; Oc., occultation; Tr., transit of the satellite; Sh., transit of the shadow.

Saturn's Satellites.



Greatest elongations visible in the United States.

[From the *American Ephemeris.*]

CENTRAL STANDARD TIME. NOON = 0h

I. Mimas. Period 0d 22h.6.

1923	d	h		d	h	1923	d	h		d	h
July	1	8.2 W	July	9	8.5 E	July	16	10.1 W	July	24	10.4 E
	6	12.6 E		10	7.1 E		17	8.8 W		25	9.0 E
	7	11.2 E		14	12.9 W		18	7.4 W		26	7.7 E
	8	9.8 E		15	11.5 W		23	11.8 E			

1923	d	h		d	h	1923	d	h		d	h
Aug.	1	10.7 W	Aug.	3	8.0 W	Aug.	9	11.0 E	Aug.	11	8.3 E
	2	9.3 W		4	6.6 W		10	9.6 E		12	6.9 E

II. Enceladus. Period 1d 8h.9.

July	0	20.1 E	July	9	1.4 E	July	17	6.8 E	July	25	12.1 E
	2	5.0 E		10	10.3 E		18	15.7 E		26	21.0 E
	3	13.8 E		11	19.2 E		20	0.6 E		28	5.9 E
	4	22.7 E		13	4.1 E		21	9.5 E		29	14.8 E
	6	7.6 E		14	13.0 E		22	18.3 E		30	23.7 E
	7	16.5 E		15	21.9 E		24	3.2 E			
Aug.	1	8.6 E	Aug.	4	2.4 E	Aug.	6	20.2 E	Aug.	9	14.0 E
	2	17.5 E		5	11.3 E		8	5.1 E			

III. Tethys. Period 1d 21h.3.

July	2	6.4 E	July	9	19.7 E	July	17	9.0 E	July	24	22.2 E
	4	3.7 E		11	17.0 E		19	6.3 E		26	19.6 E
	6	1.0 E		13	14.3 E		21	3.6 E		28	16.9 E
	7	22.1 E		15	11.6 E		23	0.9 E		30	14.2 E
Aug.	1	11.6 E	Aug.	3	8.9 E	Aug.	5	6.2 E	Aug.	7	3.5 E

IV. Dione. Period 2d 17h.7.

July	2	11.0 E	July	10	16.1 E	July	18	21.3 E	July	27	2.4 E
	5	4.7 E		13	9.8 E		21	15.0 E		29	20.1 E
	7	22.4 E		15	11.6 E		24	8.7 E			
Aug.	1	13.8 E	Aug.	4	7.6 E	Aug.	7	1.3 E	Aug.	9	19.0 E

V. Rhea. Period 4d 12h.5.

July	4	7.8 E	July	13	8.7 E	July	22	9.7 E	July	31	10.7 E
	8	20.2 E		17	21.2 E		26	22.2 E			
Aug.	4	23.2 E	Aug.	9	11.8 E						

VI. Titan. Period 15d 23h.3.

July	5	20.4 W	July	13	21.5 E	July	21	19.9 W	July	29	21.0 E
Aug.	6	19.7 W	Aug.	14	20.9 E	Aug.	22	19.8 W			

VII. Hyperion. Period 21d 7h.6.

July	9	22.9 W	July	22	0.0 E	July	31	8.5 W
Aug.	12	8.9 E						

VIII. Japetus. Period 79d 22h.1.

July	14	14.3 S	Aug.	4	5.5 E

NOTE—E, Eastern Elongation; W, Western Elongation; S, Superior Conjunction (north of planet).

The Occultation of Aldebaran, 19 April, 1923.

	h	m	s				
Disappearance	10	17	37	G. M. T.	Position	Angle*	
Reappearance	11	35	41	"	"	"	264°.5
Duration	1	18	4				

*It was not possible to distinguish the dark limb of the moon from the sky.

Roe Observatory, 4 May, 1923. E. D. ROE, JR.

Occultation of Star by Jupiter. — With the 15-inch visual refractor of the Harvard Observatory, Professor King observed on May 7 the Emersion of the star B. D. —14°4045, from occultation by Jupiter, at 4h 33m 0s G. M. T.

The star was clearly seen at $14^h\ 33^m\ 40^s$ G. M. T. The sky was clear at the time of observation, but the seeing was poor.

The occulted star is of the seventh magnitude. Mr. L. J. Comrie, of Swarthmore College, made the necessary predictions. (*Cf.* Jour. B. A. A., **33**, 156, 1923.)

COMET AND ASTEROID NOTES.

New Comet?—A comet was announced as discovered by Metcalf on May 7, 1923, in right ascension $17^h\ 31^m$; declination north 12° 20′. Magnitude nine; moving slow.

This may be D'Arrest's periodic comet, which was near Jupiter in 1919 and suffered considerable disturbance of its path. According to the ephemeris given in another note D'Arrest's comet should have been about 30^m west of the place of the object found by Metcalf.

No word of further observations of Metcalf's comet has been received. At Northfield we were unable to find it, with clear sky, on May 12.

D'Arrest's Comet.—The following Elements have been obtained by applying the Jupiter perturbations during the last revolution to *Braae's* 1917 Elements.

$$\begin{aligned} T &= 1923\ \text{Sept. } 14.12\ \text{G. M. T.} \\ \omega &= 174^\circ\ 7'\ 15'' \\ \Omega &= 143\ \ 32\ \ 18 \quad \} 1925.0 \\ i &= 18\ \ 3\ \ 47 \\ e &= 0.6169 \\ \log a &= 0.5478 \\ \log q &= 0.1311 \end{aligned}$$

The accompanying Search Ephemeris has been computed from the above Elements, with the exception of T, for which Sept. 14.5 G. M. T. has been adopted for convenience of computation.

SEARCH EPHEMERIS.

G. M. Midnight 1923		R. A. h m	N. Decl. ° ′	Log r	Log Δ
May	5	17 2.3	10 46	0.295	0.045
	9	1.9	11 38		
	13	1.0	12 29	0.282	0.011
	17	16 59.8	13 16		
	21	58.0	14 0	0.269	9.979
	25	55.9	14 38		
	29	53.3	15 11	0.257	9.951
June	2	50.3	15 37		
	6	47.2	15 55	0.244	9.925
	10	44.1	16 6		
	14	40.9	16 5	0.231	9.902
	18	37.7	15 53		
	22	34.6	15 32	0.218	9.883
	26	31.8	15 0		
	30	16 29.4	14 17	0.205	9.868

G. M. Midnight 1923		R. A. h m	N. Decl. ° ′	Log r	Log Δ
July	4	16 27.4	13 23		
	8	26.0	12 19	0.193	9.856
	12	25.2	11 6		
	16	16 25.2	9 42	0.181	9.847

F. R. Cripps.

British Astronomical Association Circular No. 2.
April 27, 1923.

Ephemeris of Comet 1922 *c* (Baade). — Baade's comet was observed on March 18 and 19, when its brightness was 12.7 magnitude. It has since passed by the sun and may possibly be observed with some of the large telescopes. The following ephemeris, computed by Bengt Strömgren, is given in *Nordisk Astronomisk Tidsskrift* 1923, No. 2:

Ephemeris of Baade's Comet 1922 *c*

		True α h m s	True δ ° ′	log r	log Δ
June	30	3 52 57	+12 21	0.5464	0.6270
July	4	3 57 18	+12 03		
	8	4 01 30	+11 43	0.5541	0.6249
	12	4 05 33	+11 22		
	16	4 09 26	+11 00	0.5616	0.6219
	20	4 13 09	+10 37		
	24	4 16 42	+10 12	0.5691	0.6181
	28	4 20 04	+ 9 46		
Aug.	1	4 23 16	+ 9 19	0.5764	0.6136
	5	4 26 16	+ 8 51		
	9	4 29 04	+ 8 21	0.5837	0.6085

Ephemeris of Comet 1922 *d* (Skjellerup). — The following elements of Skjellerup's comet 1922 *d* were computed by Mr. H. E. Wood from observations 1922 Nov. 28, 1923 Jan. 9 and Feb. 17:

$$\begin{aligned} T &= 1923\ \text{Jan.}\ 3.7685\ \text{G. M. T.} \\ \omega &= 264^\circ\ 36'\ 12'' \\ \Omega &= 262\ \ 03\ \ 06 \\ i &= \ \ 23\ \ 22\ \ 13 \\ \log q &= 9.96618 \end{aligned} \Big\} 1923.0$$

From these elements Mr. Bengt Strömgren has computed the following ephemeris, given in *Nordisk Astronomisk Tidsskrift* 1923, No. 2:

1923		α h m	δ ° ′
June	3	18 54.3	—16 39
	11	18 43.5	—15 48
	19	18 32.5	—15 03
	27	18 22.2	—14 26
July	5	18 13.0	—13 56
	13	18 05.2	—13 33
	21	17 59.0	—13 17
	29	17 54.5	—13 06
Aug.	6	17 51.5	—13 00
	14	17 50.1	—12 58
	22	17 50.0	—12 59

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1923							
					July				August			
	h m	° ′		d h	d h		d h		d h		d h	
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8			25	4			29	2
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	11	8	26	16	11	0	26	8
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	6	23	21	22	5	21	20	20
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6	23	19	5	6	13	24	21
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	6	7	23	10	9	14	26	17
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	8	9	22	3	9	17	25	10
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	10	9	24	17	8	1	22	10
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	3	2	20	16	7	5	24	19
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	3	6	19	4	12	0	27	21
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6			17	17			19	1
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	5	3	22	8	8	13	25	18
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	9	12	23	2	5	17	19	7
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	8	20	24	15	9	11	25	6
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	4	16	21	6	6	21	23	12
RV Persei	4 04.2	+33 59	9.5—12.0	1 23.4	9	15	25	10	10	5	26	0
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	7	5	20	10	2	14	29	0
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	9	11	28	8	6	18	25	16
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	10	12	22	22	4	8	29	4
TT Aurigæ	5 02.8	+39 27	7.8— 8.7	0 16.0	5	11	18	19	1	3	21	1
RY Aurigæ	11.5	+38 13	10.7—11.7	2 17.5	9	16	26	0	3	4	19	12
RZ Aurigæ	42.9	+31 40	10.6—13.3	3 00.3	5	23	18	0	5	2	23	4
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	5	12	22	20	9	4	26	12
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	7	19	28	14	8	0	28	20
SV Gemin.	54.6	+24 28	9.8—<11	4 00.2	4	22	20	22	5	23	22	0
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	7	14	25	19	6	6	23	10
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	7	15	24	10	4	15	21	10
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	4	0	20	9	5	18	22	4
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	3	20	19	2	3	8	18	14
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	9	10	21	15	2	20	27	6
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	7	22	22	6	5	14	19	22
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	8	14	22	6	11	16	25	8
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	3	22	22	13	10	3	28	18
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	10	18	23	23	6	5	19	10
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	10	17	27	12	13	7	30	2
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	4	16	24	0	5	20	25	3
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	8	21	23	10	7	0	21	13
X Carinae	8 29.1	—58 53	7.9— 8.7	0 13.0	10	20	27	2	12	7	28	13
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	10	21	29	20	8	8	27	7
RX Hydræ	9 00.8	— 7 52	9.1—10.5	2 6.8	3	20	17	13	7	1	20	18
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	6	1	23	20	4	17	22	12
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	4	1	24	7	6	19	20	6
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	5	8	20	4	4	1	18	20
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	6	7	19	11	8	7	21	12
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	4	19	22	9	9	0	26	14
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	3	7	17	23	8	22	23	14
Z Draconis	11 39.8	+72 49	9.9—13.6	1 08.6	6	21	20	11	9	20	23	10
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	7	1	22	2	6	2	21	2
RS Can. Ven.	13 06.3	+36 28	7.5—12.5	4 19.1	7	4	26	8	4	22	24	3
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	4	23	19	20	3	17	18	14
133926 Hydræ	13 39.0	—26 23	8.6—12.7	2 21.5	10	0	21	14	7	23	25	8

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1923							
					July				August			
	h m	° ′		d h	d	h	d	h	d	h	d	h
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	5	9	19	8	9	7	22	6
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	9	23	23	19	13	12	27	7
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.3	6	8	23	5	9	1	25	21
SS Librae	15 43.4	—15 14	9.3—11.5	0 18.4	8	1	22	9	5	18	20	3
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	7	5	21	21	5	13	20	5
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	10	5	26	17	3	23	20	12
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	8	23	26	16	13	9	31	2
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	10	17	31	11	21	5		
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	2	18	23	4	5	18	19	9
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	4	13	21	8	7	2	26	21
u Herculis	13.6	+33 12	4.6— 5.4	2 01.2	5	6	23	17	5	1	23	11
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	5	1	23	14	4	23	23	11
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	5	13	20	7	4	1	18	19
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	8	8	24	17	1	21	18	6
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22.6	5	4	20	6	4	8	19	10
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	6	16	22	3	6	15	22	3
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	6	8	22	8	7	7	23	6
WX Sagittarii	53.6	—17 24	9.2—10.8	2 03.1	8	12	25	13	11	14	28	15
WY Sagittarii	17 54.9	—23 1	9.5—10.6	4 16.0	9	10	28	2	6	11	25	3
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	8	18	29	11	8	18	29	11
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	7	12	22	0	5	12	20	0
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	8	9	22	5	11	22	25	18
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2	3	0	18	3	2	6	17	9
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	5	6	19	13	2	21	17	5
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	7	0	20	6	10	14	24	20
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	4	23	21	13	7	4	23	19
RR Draconis	40.8	+62 34	9.3—13	2 19.9	8	0	25	0	2	11	19	11
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	8	6	21	13	10	11	23	18
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	5	8	31	3	13	1	25	23
U Scuti	18 48.9	—12 44	9.1— 9.6	0 22.9	5	14	20	21	5	3	20	10
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	8	19	23	23	8	2	23	6
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	3	22	18	7	8	21	23	7
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	10	6	28	4	6	3	24	0
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	3	6	16	19	6	2	19	14
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	6	13	21	7	5	0	19	18
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	8	0	22	22	7	16	23	9
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	4	6	23	20	5	21	18	22
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	3	23	21	23	2	23	21	0
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	5	18	19	1	7	23	21	5
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	7	1	25	8	12	15	30	22
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	6	3	23	0	8	11	25	17
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	4	13	24	22	7	11	21	1
UW Cygni	19.6	+42 55	10.5—13	3 10.8	9	3	22	22	5	18	19	13
V Vulpec.	32.3	+26 15	8.2— 9.8	37 19.0			28	7				
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	3	11	22	16	10	22	30	3
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	5	6	23	16	11	1	29	11
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	10	1	28	0	6	0	23	23
WZ Cygni	48.3	+38 27	9.9—10.8	0 14.0	8	10	23	14	7	19	23	0
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	5	9	25	14	4	17	24	22
RY Aquarii	14.8	—11 14	8.8—10.4	1 23.2	2	19	18	13	3	6	19	1
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	3	7	23	14	2	17	23	1
UZ Cygni	55.2	+43 52	8.9—11.6	31 07.3			31	14			31	21
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	7	23	23	12	8	1	23	15
VW Pegasi	51.7	+32 41	10.0—10.6	5 06.4	9	6	25	2	9	21	25	16
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.3	7	18	22	20	6	21	21	23
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	4	10	20	22	6	10	22	22

Maxima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1923							
					July				August			
	h m	° ′		d h	d	h	d	h	d	h	d	h
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			15	2			21	11
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	10	0	26	6	11	13	27	20
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	8	0	23	12	8	0	23	12
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	3	3	17	22	1	17	16	12
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	7	16	23	13	8	10	24	7
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	6	9	22	5	6	14	22	4
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	13	12	29	22	15	7	31	17
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	10	8	27	12	13	16	30	19
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	5	13	27	19	7	22	30	4
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	4	12	16	3	8	9	20	0
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	4	13	19	21	4	5	19	12
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	10	14	20	17	10	0	20	3
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	9	7	24	18	9	4	24	15
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	9	12	20	14	6	4	22	18
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	8	1	23	4	7	7	22	10
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3			24	8			20	9
RT Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	7	2	22	0	5	22	20	20
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	11	14	27	10	12	6	28	2
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	3	18	24	1	3	5	23	12
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	9	15	31	22			23	4
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	7	23	23	21	8	18	24	15
V Carinæ	8 26.7	—59 47	7.4— 8.1	6 16.7	2	5	22	7	11	9	24	18
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	4	7	22	20	10	10	28	23
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	5	2	22	14	9	1	26	13
Z Leonis	9 46.4	+27 22	7.9— 9.6	59 00.0					7	15		
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	4	8	17	21	7	6	20	20
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	3	20	17	1	5	21	19	0
S Muscae	12 07.4	—69 36	6.4— 7.3	9 15.8	3	14	22	22	11	5	30	13
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	4	11	20	10	5	8	21	7
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	4	3	17	15	6	19	20	6
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	6	9	18	1	4	12	21	23
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	8	10	22	12	10	6	24	7
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	5	7	22	14	8	20	26	3
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	9	20	26	5	11	15	28	0
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	3	12	24	13	7	15	21	16
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	8	9	24	20	10	6	25	17
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	6	1	22	13	2	13	19	0
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	8	12	23	16	7	19	22	21
R Triang.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	9	3	22	16	5	6	18	19
S Triang.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	9	4	21	20	3	11	22	11
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	10	16	20	10	8	22	28	10
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	7	10	25	3	11	20	29	14
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	9	3	21	6	8	10	20	13
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	8	10	22	11	5	11	19	12
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9	5	9	22	12	8	15	25	18
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	4	12	19	16	3	21	19	1
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	3	1	20	8	6	16	24	0
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	7	23	21	10	10	16	24	4
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	10	22	21	6	10	22	21	7
RZ Lyræ	18 39.9	+32 42	9.9—11.2	0 12.3	9	0	21	7	8	17	20	23
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	4	9	22	6	9	2	20	23
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	10	23	29	3	7	6	25	10
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	6	0	20	1	3	2	24	4

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1923							
					July				August			
	h m	° ′		d h	d h		d h		d h		d h	
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	8	21	22	21	5	21	19	21
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	7	17	23	16	8	15	24	14
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	8	5	23	13	7	23	23	8
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	10	2	24	12	7	20	22	6
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	8	4	24	23	2	7	19	2
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	5	3	24	0	5	17	24	16
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	9	8	25	18	11	3	27	12
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	7	2	20	9	7	3	20	10
WY Cygni	52.3	+30 03	9.6—10.4	0 13.5	3	13	17	0	6	4	19	15
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	3	19	23	23	6	9	19	19
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	14	7	29	0	12	17	27	10
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	8	8	24	1	8	18	24	12
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	7	18	21	12	4	7	18	2
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	7	17	22	7	5	22	20	12
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	9	18	27	2	13	9	30	16
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	8	16	24	18	9	21	20	14
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	4	5	26	0	5	21	27	16
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	7	12	20	8	8	14	21	10
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	7	14	22	12	6	11	21	10
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	9	16	26	0	11	8	27	16
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	7	6	23	13	8	21	25	5
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	9	13	22	4	10	1	22	16
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	3	4	27	16	8	19	20	22
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	10	22	24	21	7	20	21	19

Monthly Report of the American Association of Variable Star Observers, March 20 to April 20, 1923.

In spite of bad weather conditions unusually good lists have been received from Messrs. Bouton, Lacchini and Peltier. SS Cygni was at maximum on April 14, only thirty days following its previous rise. SS Aurigae was caught on the rise by Mr. Waterfield on April 9, an interval of 64 days having elapsed since the previous maximum. R Coronae Borealis 154428 will undoubtedly hold the center of attention for some time to come, as it is at present passing through one of its mysterious and spectacular periods of irregularity and faintness. It demands careful and constant observation.

The following observers contributed to this report: Messrs Allen "Al", Ancarani "An", Baldwin "Bl", Bouton "B", Brocchi "Br", Burrill "Bu", Chandler "Cd", Christie "Ct", Ginori "Gi", Hill "Hi", Kanda "Kd", Lacchini "L", Leavenworth "Lv", Mrs. Lytle "Ly", McAteer "M", Nakamura "Nk", Peltier "Pt", Proctor "Pc", Rhorer "Ro", Skaggs "Sg", Suter "Su", Swanson "Sw", Waterfield "Wf", Yalden "Ya", Miss Young "Y".

Howard O. Eaton, Recording Secretary.

VARIABLE STAR OBSERVATIONS, March 20 to April 20, 1923.

March 0 = J. D. 2423479 April 0 = J. D. 2423510

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
000339 V SCULPTORIS—						
	3455.9	10.7	Bl,	3475.9	11.1	Bl.
	3468.9	10.7	Bl,			
001032 S SCULPTORIS—						
	3455.9	8.6	Bl,	3475.9	9.7	Bl.
	3468.9	9.0	Bl,			
001755 T CASSIOPEIAE—						
	3497.3	10.7	L,	3508.3	10.4	L,
	3498.4	9.6	Gi,	3516.6	9.5	Pt.
001838 R ANDROMEDAE—						
	3480.9	8.8	Kd,	3494.9	8.8	Kd,
	3484.9	8.7	Kd,	3528.9	9.3	Pt.
001862 S TUCANAE—						
	3456.0	12.6	Bl.			
002833 W SCULPTORIS—						
	3459.0	13.0	Bl.			
003179 Y CEPHEI—						
	3499.9	8.4	Kd.	3503.7	8.8	Br.
004047 U CASSIOPEIAE—						
	3516.6	11.3	Pt,	3516.6	11.3	Wf.
004435 X SCULPTORIS—						
	3459.0	14.0	Bl.			
004746a RV CASSIOPEIAE—						
	3500.3	12.1	L,	3518.6	13.0	Wf.
	3516.6	12.2	Pt,			
004958 W CASSIOPEIAE—						
	3498.4	8.3	Gi,	3516.6	8.8	Pt.
005475 U TUCANAE—						
	3459 0	13.2	Bl,	3475.9	12.2	Bl.
	3468.9	12.6	Bl,			
010630 U SCULPTORIS—						
	3456.0	11.0	Bl,	3475.9	12.3	Bl.
	3468.9	11.5	Bl,			
010940 U ANDROMEDAE—						
	3516.6	11.8	Wf.			
011041 UZ ANDROMEDAE—						
	3518.6	11.7	Wf.			
011272 S CASSIOPEIAE—						
	3496.7	12.0	Br,	3516.6	10.8	Wf,
	3516.6	11.6	Pt,	3520.7	11.3	Wf,
013238 RU ANDROMEDAE—						
	3518.6	12.6	Wf.			
014958 X CASSIOPEIAE—						
	3499.9	11.7	Kd.	3516.6	11.5	Pt.
015354 U PERSEI—						
	3497.7	9.4	Sg,	3518.7	9.6	Sg.
	3516.6	9.0	Pt,			
021024 R ARIETIS—						
	3498.3	11.7	Gi,	3516.6	10.7	Wf.
	3499.9	11.3	Kd,			
021143a W ANDROMEDAE—						
	3492.4	12.0	Gi,	3518.6	12.5	Wf.
	3516.6	12.9	Pt,			
021281 Z CEPHEI—						
	3503.7	12.3	Br.			
021403 o CETI—						
	3430.3	3.3	An,	3491.8	2.8	Nk,
	3477.9	3.0	Kd,	3493.8	2.8	Nk,
	3478 9	2.9	Kd,	3493.9	3.1	Kd,
	3479.9	2.9	Kd,	3496.3	3.1	L,
	3482.9	3.0	Kd,	3497.7	2.8	Sg,
	3484.9	3.0	Kd,	3499.9	3.1	Kd,
	3485.3	2.9	An,	3501.8	3.2	Nk,
	3488.9	3.1	Kd,	3501.9	3.1	Kd,
	3489.3	3 0	L,	3504.3	3.6	L,
021558 S PERSEI—						
	3516.6	10.2	Pt.			
022150 RR PERSEI—						
	3516.6	10.1	Pt,	3518.6	10.1	Wf.
022426 R FORNACIS—						
	3456.0	11.3	Bl,	3475.9	11.4	Bl.
	3468.9	11.4	Bl,			
023133 R TRIANGULI—						
	3484.9	11.8	Kd,	3516.6	10.2	Pt.
	3501.9	11.8	Kd,			
024217 T ARIETIS—						
	3499 9	9.8	Kd.			
024356 W PERSEI—						
	3425.0	11.0	Nk,	3499.6	9.0	B,
	3426.0	11.1	Nk,	3516.6	8.8	Pt.
	3469.1	10.2	Nk,			
025050 R HOROLOGII—						
	3456.0	13.0	Bl.			
025751 T HOROLOGII—						
	3456.0	9.5	Bl,	3475.9	7.8	Bl.
	3468.9	8.3	Bl,			
030514 U ARIETIS—						
	3498.3	12.4	Gi.			
031401 X CETI—						
	3480.9	9.2	Kd,	3497.3	10.2	L,
	3484.9	9.5	Kd,	3501.9	10.0	Kd.
	3489.3	9.7	L,			
032043 Y PERSEI—						
	3516.6	8.0	Pt.			
032335 R PERSEI—						
	3492.3	11.2	Gi,	3516.6	8.2	Pt,
	3499.9	10.9	Kd,	3516.6	9.1	Wf.
	3507.3	9.4	Gi,			
042215 W TAURI—						
	3496.7	10.6	Sg,	3516.6	10.1	Pt,
	3513.5	10.6	B,	3517.7	10.4	Sg.
042309 S TAURI—						
	3516.5	[13.0	B.			
043065 T CAMELOPARDALIS—						
	3497.3	9.6	L,	3516.6	8.5	Pt.
	3508.3	9.0	L,			
043208 RX TAURI—						
	3505.5	12.4	B,	3523.6	11.0	B.
	3516.6	11.5	Pt,			
043263 R RETICULAE—						
	3456.0	13.5	Bl.			

VARIABLE STAR OBSERVATIONS, March 20 to April 20, 1923—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
043274 X CAMELOPARDALIS—						
	3505.6	8.2	B.	3518.7	8.3	Wf.
	3516.6	8.2	Pt,			
043562 R DORADUS—						
	3456.0	5.5	Bl.			
043738 R CAELI—						
	3456.0	8.6	Bl.	3476.0	8.2	Bl.
	3469.0	8.4	Bl,			
044617 V TAURI—						
	3496.6	13.5	B.	3516.6	12.0	B.
	3516.6	11.7	Pt,	3516.6	11.8	Wf.
045307 R ORIONIS—						
	3492.4	13.6	Gi,	3518.7	13.4	Wf.
	3516.6	13.3	B,			
045514 R LEPORIS—						
	3489.3	9.9	L,	3508.3	10.0	L,
	3496.3	10.2	L,	3515.6	9.7	Pt.
	3505.6	9.0	B,			
050003 V ORIONIS—						
	3515.6	13.0	Pt.			
050022 T LEPORIS—						
	3456.0	8.6	Bl.	3475.9	9.0	Bl,
	3469.0	8.7	Bl.	3505.6	10.1	B.
050848 S PICTORIS—						
	3456.0	10.8	Bl,	3475.9	10.9	Bl.
	3469.0	10.8	Bl.			
050953 R AURIGAE—						
	3505.6	10.7	Lv,	3519.6	10.4	Ya,
	3515.6	11.0	Pt,	3527.6	11.0	Sw.
	3518.8	10.5	Wf.			
051247 T PICTORIS—						
	3456.0	8.8	Bl,	3475.9	9.9	Bl.
	3469.0	9.4	Bl,			
051533 T COLUMBAE—						
	3456.0	7.6	Bl,	3485.0	9.5	Kd,
	3469.0	7.6	Bl,	3500.0	10.1	Kd.
	3476.0	8.0	Bl,			
052034 S AURIGAE—						
	3503.3	9.0	An,	3510.6	8.7	B,
	3503.3	8.7	L,	3515.6	8.0	Pt.
052036 W AURIGAE—						
	3492.4	11.4	Gi,	3513.6	12.4	B,
	3497.3	12.2	L,	3515.6	13.1	Pt.
	3499.6	12.2	B,			
052404 S ORIONIS—						
	3496.6	13.2	B,	3515.6	[13.4	B.
	3515.6	13.5	Pt,			
053005a T ORIONIS—						
	3433.3	10.2	An,	3504.3	10.2	L,
	3469.0	11.1	Nk,	3505.6	10.5	Pt,
	3484.3	11.5	L,	3507.7	10.5	Pt,
	3489.3	9.9	L,	3508.3	10.2	L,
	3496.3	10.4	L,	3510.5	10.5	Pt,
	3497.3	10.1	L,	3515.6	10.0	Pt,
	3498.3	10.4	L,	3516.6	10.5	Pt,
	3499.6	11.1	B,	3516.6	11.0	B,
	3500.3	11.0	L,	3518.6	9.7	Pt,
	3501.3	10.6	L,	3520.7	10.2	Pt,
053005a T ORIONIS—Continued.						
	3503.3	10.3	,L	3523.6	11.6	B,
	3503.3	10.0	An,	3527.6	11.0	Pt,
	3503.6	10.5	Pt,	3529.6	11.0	Pt.
053068 S CAMELOPARDALIS—						
	3515.6	9.4	Ya,	3519.6	9.9	Pt.
053326 RR TAURI—						
	3515.6	12.0	B,	3524.6	11.7	B.
053337 RU AURIGAE—						
	3503.7	11.9	Br.			
053531 U AURIGAE—						
	3515.6	13.5	B,	3518.8	13.4	Wf.
	3515.6	13.2	Pt,			
054319 SU TAURI—						
	3489.3	9.6	L,	3516.6	9.3	Wf,
	3496.6	9.4	Br,	3517.6	9.5	B,
	3497.3	9.5	L,	3518.6	9.5	Pt,
	3498.3	9.5	L,	3518.7	9.4	Wf,
	3499.6	9.5	B,	3519.7	9.3	Wf,
	3502.7	9.6	Pt,	3519.7	9.4	Br,
	3503.3	9.5	L,	3520.6	9.4	Cd,
	3503.3	9.4	An,	3520.7	9.8	Pt,
	3504.3	9.6	L,	3520.7	9.3	Wf,
	3505.6	9.5	Pt,	3522.6	9.7	Pc,
	3505.6	9.5	Pt,	3523.5	9.5	B,
	3507.7	9.5	Pt,	3526.6	9.8	Pt,
	3510.5	9.5	Pt,	3527.6	9.6	Pt,
	3513.6	9.5	B,	3528.6	9.7	Pt,
	3515.6	9.5	Pt,	3529.6	9.6	Pt.
	3516.6	9.7	Pt,			
054331 S COLUMBAE—						
	3459.0	[13.1	Bl.			
054615a Z TAURI—						
	3518.7	14.1	Wf.			
054615c RU TAURI—						
	3518.7	[14.0	Wf.			
054629 R COLUMBAE—						
	3459.0	[13.0	Bl.			
054920a U ORIONIS—						
	3437.0	10.6	Nk,	3505.6	11.9	B,
	3469.0	11.4	Nk,	3515.6	12.0	Pt,
	3485.0	11.7	Kd,	3517.6	12.0	B.
	3500.0	11.6	Nk.			
054945 TW AURIGAE—						
	3480.9	8.5	Kd.	3502.0	8.3	Kd.
	3495.0	8.3	Kd,			
054974 V CAMELOPARDALIS—						
	3494.5	10.7	Gi,	3516.7	11.1	Wf,
	3509.4	10.5	Gi,	3520.7	11.5	Wf,
	3513.6	11.4	B,	3522.6	11.4	B.
	3515.6	11.5	Pt,			
055353 Z AURIGAE—						
	3510.6	9.7	B,	3516.7	10.0	Wf,
	3515.6	10.3	Pt,	3520.7	10.2	Wf.
055686 R OCTANTIS—						
	3456.0	11.5	Bl.	3476.0	11.8	Bl.
	3569.0	11.7	Bl.			
060450 X AURIGAE—						
	3499.6	11.5	B,	3515.6	12.5	B,
	3502.0	12.4	Kd,	3515.6	12.4	Pt.

VARIABLE STAR OBSERVATIONS. March 20 to April 20, 1923—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
060547 SS AURIGAE—				
	3484.3	[14.0 L,	3508.4	[12.7 Gi,
	3485.4	[13.3 L,	3509.4	[13.3 Gi,
	3489.3	[14.0 L,	3509.7	[12.6 Pt,
	3492.4	[13.9 Gi,	3510.3	[12.4 L,
	3494.4	[13.9 Gi,	3510.7	[11.0 Pt,
	3495.4	[13.9 Gi,	3513.6	[13.5 B,
	3496.3	14.8 L,	3514.6	[13.3 Y,
	3496.6	[12.4 Br,	3515.6	[12.6 Pt,
	3497.3	[14.0 L,	3516.6	[12.6 Pt,
	3498.3	[14.0 L,	3516.6	14.9 Wf,
	3493.4	[13.9 Gi,	3518.6	[12.6 Pt,
	3499.6	[13.8 B,	3518.7	14.7 Wf,
	3500.3	[14.0 L,	3519.7	[12.6 Br,
	3501.3	[13.3 L,	3519.7	13.1 Wf,
	3502.7	[12.4 Pt,	3519.8	12.1 Wf,
	3503.3	[13.3 L,	3520.6	10.9 Pc,
	3503.5	[13.8 Gi,	3520.7	10.8 Wf,
	3503.6	[12.4 Pt,	3520.7	10.7 Pt,
	3503.7	[12.6 Br,	3522.6	10.8 Pc,
	3504.3	[13.3 L,	3522.6	10.6 B,
	3504.4	[13.3 Gi,	3523.6	10 6 B,
	3505 6	14.0 Lv,	3524.6	10.7 B,
	3505.6	[14.0 Pt,	3526.6	10.9 B,
	3506.4	[13.3 Gi,	3526.6	10.9 Pt,
	3506.6	[12.6 Pt,	3527.6	11.2 Pt,
	3507.3	[13.3 L,	3527.7	11.0 Hi,
	3507.4	[13.3 Gi,	3528.6	11.2 Pt,
	3507.7	[12.6 Pt,	3529.6	11.8 Pt,
	3508.3	[13.3 L,		
061647 V AURIGAE—				
	3496.6	12.4 B,	3522.6	11.6 B,
	3513.6	11.6 B,		
061702 V MONOCEROTIS—				
	3500.0	9.3 Kd,	3515.6	7.0 Pt,
063159 U LYNCIS—				
	3514.6	13.8 Y,		
063308 R MONOCEROTIS—				
	3496.6	11.6 B,	3515.6	10.5 Pt,
	3496.7	11.5 Br,	3523.6	11.6 B
	3513.6	11.5 B,		
064030 X GEMINORUM—				
	3492.4	9.6 Gi,	3505.6	10.3 B,
	3502.0	11.1 Kd,	3507.4	10.6 Gi
064707 W MONOCEROTIS—				
	3510.6	9.8 B,	3523.6	10.3 B,
	3515.6	10.5 Pt,		
065111 Y MONOCEROTIS—				
	3496.6	12.2 B,	3515.6	11.0 Pt,
	3502.0	11.9 Kd,	3515 6	11.2 Y,
	3513.6	11.1 B,	3526.6	10.8 B,
065208 X MONOCEROTIS—				
	3489.3	7.8 L,	3508.3	8.4 L,
	3497.3	7.8 L,		
065355 R LYNCIS—				
	3494.4	11.2 Gi,	3520.7	10.5 Wf,
	3507.4	11.0 Gi,	3526.6	10.0 B,
	3516.7	10.7 Wf,		
070109 V CANIS MINORIS—				
	3496.6	[13.8 B,	3518.7	[14.0 Wf,
070122a R GEMINORUM—				
	3510.6	10.6 B,	3522.6	12.0 B,
	3515.7	12.0 Pt,		
070122b Z GEMINORUM—				
	3515.7	12.4 Pt,	3522.6	12.4 B,
070122c TW GEMINORUM—				
	3522.6	8.3 B,		
070310 R CANIS MINORIS—				
	3489.3	8.4 L,	3510.6	8.8 B,
	3500.3	8.7 L,	3524.6	9.3 B,
	3502.0	10.0 Kd,		
071713 V GEMINORUM—				
	3496.7	9.4 B,	3515.7	10.3 Pt,
	3500.0	9.9 Kd,	3522.6	10.4 B,
	3513.6	10.1 B,		
072708 S CANIS MINORIS—				
	3489.3	10.2 L,	3515.7	9.1 Pt,
	3496.7	9.8 Sg,	3518.6	9.0 Pc,
	3496.7	9.5 B,	3518.7	9.0 Sg,
	3499.7	10.2 Ct,	3519.6	9.2 Cd,
	3500.0	10.2 Kd,	3524.7	8.6 Ct,
	3500.3	9.7 L,	3526.6	8.7 B,
	3513.6	9.0 B,	3532.6	8.3 Ro,
	3514.7	9.0 Ct,		
072811 T CANIS MINORIS—				
	3485.0	12.6 Kd,	3515.6	13.4 B,
	3496.6	13.2 B,	3515.7	12.4 Pt,
073173 S VOLANTIS—				
	3456.0	10.8 Bl,	3476.0	11.6 Bl,
	3469.0	11.8 Bl,		
073508 U CANIS MINORIS—				
	3489.3	10.3 L,	3515.6	10.6 Y,
	3496.7	9.8 B,	3515.7	10.4 Pt,
	3500.3	10.6 L,	3522.7	11.0 B,
	3513.6	10.8 B,		
073723 S GEMINORUM—				
	3485.0	14.0 Kd,	3519.6	[13.8 B,
074241 W PUPPIS—				
	3456.0	12.1 Bl,	3476.9	10.6 Bl,
	3469.0	11.0 Bl,		
074323 T GEMINORUM—				
	3485.0	13.2 Kd,	3517.6	[13.9 B,
074922 U GEMINORUM—				
	3489.3	14.0 L,	3515.6	[13.3 Y,
	3492.4	14.0 Gi,	3515.7	[13.3 Pt,
	3494.4	14.0 Gi,	3516.6	[13.7 Pt,
	3495.4	13.9 Gi,	3516.6	13.9 Wf,
	3496.3	14.0 L,	3517.6	13.9 B,
	3496.6	[13.0 Br,	3518.6	[13.7 Pt,
	3498.4	13.9 Gi,	3518.7	14.0 Wf,
	3499.6	[13.8 B,	3519.6	13.9 B,
	3502.7	[12.3 Pt,	3519.7	[13.3 Br,
	3503.5	[13.7 Gi,	3519.7	13.9 Wf,
	3503.6	[12.4 Pt,	3520.7	[14.1 Pt,
	3504.4	[13.3 Gi,	3520.7	[13.7 Wf,
	3505.4	[12.7 Gi,	3522.6	[13.7 Pc,
	3506.4	[12.7 Gi,	3522.6	[13.7 B,

VARIABLE STAR OBSERVATIONS. March 20 to April 20, 1923—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
074922 U GEMINORUM—Continued.				
	3507.4	[12.7 Gi,	3523.6	13.9 B,
	3507.6	[12.3 Pt,	3526.6	[11.4 Pt,
	3508.4	[12.8 Gi,	3527.6	[13.7 Pt,
	3509.4	[13.3 Gi,	3528.6	[13.7 Pt,
	3509.7	[11.3 Pt,	3529.6	[13.7 Pt.
	3513.6	14.0 B,		
081112 R CANCRI—				
	3497.3	6.8 L,	3524.6	7.2 B,
	3508.3	7.0 L,	3530.5	7.6 Ly,
	3510.6	6.9 B,	3542.5	8.0 Ly,
	3515.7	7.0 Pt,	3543.6	8.1 Ly,
	3516.6	7.7 Ly,	3545.6	8.3 Ly,
	3516.6	7.9 Ya,	3546.5	8.3 Ly,
	3518.6	8.2 Pc,	3547.6	8.4 Ly,
	3519.6	8.1 Ly,	3553.6	8.4 Ly.
	3522.6	7.7 Ly,		
081617 V CANCRI—				
	3494.4	12.8 Gi,	3515.7	13.0 Pt.
	3513.6	13.0 B,		
082405 RT HYDRAE—				
	3481.0	8.6 Kd,	3500.3	7.9 L,
	3484.3	7.7 L,	3516.6	8.0 B,
	3485.0	8.5 Kd,	3515.7	8.0 Pt,
	3494.9	8.4 Kd,	3529.5	8.0 Ya.
	3500.0	8.2 Kd,		
082476 R CHAMELEONTIS—				
	3459.0	[13.0 Bl.		
083019 U CANCRI—				
	3505.7	[13.5 Lv.	3519.7	13.6 B.
	3518.7	13.5 Wf.		
083350 X URSAE MAJORIS—				
	3500.6	10.8 B.	3519.6	9.4 B,
	3515.7	9.5 Pt.	3522.6	10.1 B.
	3516.6	9.5 Ya,		
084803 S HYDRAE—				
	3515.7	11.3 Pt,	3516.6	11.3 B.
084917 X CANCRI—				
	3469.0	6.9 Nk.		
085008 T HYDRAE—				
	3489.3	7.5 L,	3511.6	8.7 Ya,
	3496.7	8.0 Br,	3515.7	9.3 Pt,
	3500.4	8.3 L.	3517.6	9.0 B,
	3505.5	8.2 B.	3524.6	9.2 B.
085120 T CANCRI—				
	3474.0	9.8 Nk,	3500.4	9.3 L,
	3484.3	9.5 L.	3515.7	9.0 Pt.
090024 S PYXIDIS—				
	3516.6	12.1 Pt.		
090151 V URSAE MAJORIS—				
	3500.6	9.9 B.	3519.6	10.2 B.
090425 W CANCRI—				
	3474.0	9.8 Nk.	3500.4	10.5 L.
091868 RW CARINAE—				
	3459.0	[13.0 Bl.		
092551 Y VELAE—				
	3456.0	9.9 Bl.	3476.0	8.4 Bl,
	3469.0	8.7 Bl,		
092962 R CARINAE—				
	3456.0	5.0 Bl.	3476.0	4.7 Bl,
	3469.0	3.9 Bl,		
093014 X HYDRAE—				
	3515.7	13.0 Pt,	3519.6	11.5 B.
093178 Y DRACONIS—				
	3519.7	13.4 B.		
093934 R LEONIS MINORIS—				
	3474.0	7.2 Nk,	3515.7	7.5 Pt,
	3484.3	6.8 L,	3516.6	7.4 Ya,
	3497.3	6.9 L,	3522.6	7.4 Pc,
	3508.3	7.2 L,	3528.8	8.0 Ct.
094211 R LEONIS—				
	3496.7	10.0 Sg,	3519.6	9.9 Ly,
	3498.3	9.9 An,	3522.6	9.9 Ly,
	3499.6	9.4 B,	3522.7	7.7 Al,
	3502.0	10.0 Kd,	3524.7	9.8 Ct,
	3503.3	10.3 An,	3527.7	9.8 Ct,
	3514.7	10.3 Ct,	3530.6	9.4 Ly,
	3515.7	9.4 Pt,	3533.6	9.3 Ly,
	3516.6	10.1 Ly,	3542.5	8.8 Ly,
	3516.6	9.6 Ro,	3543.6	8.8 Ly,
	3516.6	9.8 Ya,	3545.5	8.3 Ly,
	3517.5	9.3 B,	3546.6	8.6 Ly,
	3518.6	8.9 Pc,	3547.6	8.6 Ly,
	3518.6	9.8 Ro,	3553.6	8.7 Ly.
	3518.7	9.0 Sg,		
094512 X LEONIS—				
	3484.3	12.4 L,	3500.4	[12.5 L,
	3485.4	12.6 L,	3501.3	[12.5 L,
	3489.3	[12.5 L,	3503.3	11.0 An,
	3496.3	[13.3 L,	3503.3	12.3 L,
	3497.3	[13.3 L,	3504.3	12.4 L.
	3498.3	[12.5 L,		
094622 Y HYDRAE—				
	3515.7	7.1 Pt.	3529.5	7.5 Ya.
	3516.6	7.5 Ya,		
094953 Z VELAE—				
	3459.0	13.5 Bl.		
095421 V LEONIS—				
	3500.6	13.3 B.	3515.7	13.0 Pt.
	3505.7	13.0 Lv.	3516.7	12.9 Wf.
095563 RV CARINAE—				
	3459.0	[13.1 Bl,	3469.0	14. Bl.
100661 S CARINAE—				
	3456.0	6.4 Bl,	3476.9	7.8 Bl.
	3469.0	7.7 Bl,		
101058 Z CARINAE—				
	3459.0	[12.6 Bl.		
101153 W VELAE—				
	3459.0	[13.0 Bl.		
103212 U HYDRAE—				
	3477.0	6.1 Kd,	3496.3	5.3 L,
	3479.0	6.1 Kd.	3500.1	6.2 Kd,
	3485.1	6.1 Kd.	3502.1	6.2 Kd.
	3488.1	6.1 Kd,		

VARIABLE STAR OBSERVATIONS, March 20 to April 20, 1923—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
103769 R URSAE MAJORIS—				
	3499.6	11.0 Cd,	3520.6	10.7 Cd,
	3514.6	11.4 B,	3520.7	10.5 Wf,
	3515.7	11.3 Pt,	3527.7	9.4 Bu,
	3516.7	11.0 Wf,	3527.8	9.5 M,
	3517.7	11.3 Sg,	3529.6	9.0 Ya.
	3518.7	10.5 Pc,		
104620 V HYDRAE—				
	3456.0	7.7 Bl,	3496.3	9.6 L,
	3469.0	7.9 Bl,	3515.7	8.8 Pt,
	3477.1	7.6 Bl,	3529.6	9.3 Ya.
104628 RS HYDRAE—				
	3459.0	[13.7 Bl.		
104814 W LEONIS—				
	3499.6	9.8 B,	3517.6	10.6 B,
	3505.7	10.4 Lv,	3527.7	11.0 Lv.
	3515.7	10.8 Pt,		
110506 S LEONIS—				
	3496.7	10.0 Br,	3515.7	11.0 Pt,
	3500.6	10.0 B,	3519.6	11.4 B.
111561 RY CARINAE—				
	3456.0	[13.5 Bl.		
111661 RS CENTAURI—				
	3456.0	12.6 Bl.		
114441 X CENTAURI—				
	3456.0	8.9 Bl,	3477.1	10.5 Bl.
	3469.0	9.9 Bl,		
115058 W CENTAURI—				
	3456.0	8.1 Bl,	3476.9	9.1 Bl.
	3469.0	8.8 Bl,		
115919 R COMAE BERENICES—				
	3516.7	13.5 Wf,	3527.6	12.6 Pt,
	3522.6	13.3 B,	3527.8	12.4 Lv.
120012 SU VIRGINIS—				
	3496.7	10.5 Br,	3515.7	10.7 Pt,
	3499.7	10.1 B,	3516.6	10.3 B.
120905 T VIRGINIS—				
	3527.8	12.8 Lv.		
121418 R CORVI—				
	3496.6	8.2 L,	3515.7	9.0 Pt,
	3500.0	8.6 Kd,	3517.6	8.9 B.
	3500.7	8.3 B,		
122001 SS VIRGINIS—				
	3485.0	8.9 Kd,	3508.3	9.6 L,
	3500.6	8.9 B,	3517.6	8.8 B.
122532 T CANUM VENATICORUM—				
	3496.7	10.8 Br,	3519.6	10.8 B,
	3515.7	10.1 Pt,	3527.9	10.4 M.
122803 Y VIRGINIS—				
	3489.7	11.2 L,	3500.4	10.4 L,
	3496.8	11.0 Br,	3515.6	9.8 B,
	3499.7	11.0 B,	3523.6	9.3 B.
	3500.0	10.7 Kd,		
122854 U CENTAURI—				
	3456.0	8.1 Bl,	3476.9	8.7 Bl.
	3469.0	8.5 Bl,		

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
123160 T URSAE MAJORIS—				
	3514.6	12.0 B,	3518.7	11.3 Pc,
	3515.7	11.5 Pt,	3520.6	10.9 Cd,
	3516.6	11.0 Ro,	3527.8	9.0 M,
	3516.7	[10.8 Su,	3529.6	9.5 Ya,
	3516.7	11.1 Wf,	3545.6	8.8 Ro,
	3518.6	11.0 Ro,	3553.6	8.8 Ro.
123307 R VIRGINIS—				
	3496.3	9.0 L,	3515.7	7.6 Pt,
	3500.6	7.7 B,	3517.6	7.7 B,
	3503.8	7.4 Ct,	3517.7	7.8 Ct,
	3508.3	7.4 L,	3523.8	8.2 Ct,
	3514.7	7.7 Ct,	3529.6	8.4 Ya.
123459 RS URSAE MAJORIS—				
	3496.7	10.2 Sg,	3518.6	10.3 Ro,
	3496.8	10.4 Br,	3518.7	12.7 Pc,
	3506.6	10.8 B,	3519.6	11.8 Ya,
	3514.6	11.2 B,	3520.6	11.2 Cd,
	3515.7	11.6 Pt,	3527.8	12.3 Lv,
	3516.6	10.5 Ro,	3527.8	[12.3 M,
	3516.7	11.3 Wf,	3553.6	10.0 Ro.
	3517.7	11.5 Sg,		
123961 S URSAE MAJORIS—				
	3488.3	10.1 An,	3516.7	8.9 Wf,
	3489.3	10.8 L,	3517.7	9.4 Sg,
	3496.7	10.5 Sg,	3518.6	9.2 Ro,
	3496.8	10.5 Br,	3518.7	9.0 Pc,
	3500.4	10.4 L,	3519.6	8.9 Ya,
	3500.6	10.3 Cd,	3520.6	8.8 Cd,
	3503.3	9.9 An,	3527.8	8.6 Lv,
	3506.6	9.5 B,	3527.8	8.8 M,
	3514.6	9.2 B,	3529.6	8.8 Ya,
	3515.7	9.5 Pt,	3546.6	9.1 Ro,
	3516.6	9.1 Ro,	3553.6	8.5 Ro.
	3516.7	9.3 Su,		
124204 RU VIRGINIS—				
	3496.8	12.5 Br,	3515.6	12.9 B,
	3499.7	12.6 B,	3516.7	13.2 Pt.
	3502.0	12.9 Kd,		
124606 U VIRGINIS—				
	3496.8	9.0 Br,	3515.7	10.2 Pt,
	3500.7	9.3 B,	3517.6	10.5 B.
125705a RT VIRGINIS—				
	3502.0	8.6 Kd.		
130212 RV VIRGINIS—				
	3516.7	13.8 Wf.		
131283 U OCTANTIS—				
	3456.0	8.5 Bl,	3476.9	9.3 Bl.
	3469.0	9.2 Bl,		
132002 W VIRGINIS—				
	3516.7	9.4 B,	3523.6	9.4 B.
132202 V VIRGINIS—				
	3496.8	9.8 Br,	3523.6	11.5 B.
	3516.6	10.8 B,		
132422 R HYDRAE—				
	3456.1	4.7 Bl.	3482.3	5.0 Kd,
	3469.0	4.9 Bl.	3483.3	5.0 Kd,
	3473.3	4.8 Kd.	3489.6	5.1 L,
	3478.3	4.9 Kd,	3500.1	6.1 Kd,
	3480.3	5.1 Kd,	3515.7	6.0 Pt.

VARIABLE STAR OBSERVATIONS, March 20 to April 20, 1923—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
132706 S VIRGINIS—						
	3503.8	6.5	Ct,	3516.7	7.2	Wf,
	3505.7	7.0	Ct,	3517.7	7.0	Ct.
	3514.7	7.2	Ct,	3518.7	6.6	Sg.
	3515.7	7.2	Pt,	3523.8	7.3	Ct.
133155 RV CENTAURI—						
	3456.0	7.8	Bl,	3477.1	7.7	Bl.
	3469.0	8.1	Bl,			
133273 T URSAE MINORIS—						
	3516.8	12.3	Wf.			
133633 T CENTAURI—						
	3456.0	7.4	Bl,	3478.3	6.6	Kd,
	3469.0	7.0	Bl,	3500.1	6.4	Kd,
	3477.1	6.2	Bl,	3502.1	6.5	Kd.
134236 RT CENTAURI—						
	3456.0	9.2	Bl,	3477.1	9.4	Bl.
	3469.0	9.3	Bl,			
134440 R CANUM VENATICORUM—						
	3500.0	8.1	Kd,	3516.6	8.5	B,
	3502.1	8.1	Kd,	3527.9	8.5	M.
	3515.7	8.2	Pt,			
134536 RX CENTAURI—						
	3456.0	11.6	Bl,	3469.0	11.9	Bl.
134677 T APODIS—						
	3459.0	[13.2	Bl.			
135908 RR VIRGINIS—						
	3515.7	14.0	Pt.			
140113 Z BOOTIS—						
	3516.7	14.2	Wf.			
140512 Z VIRGINIS—						
	3515.7	10.5	Pt.			
140528 RU HYDRAE—						
	3469.2	13.5	Bl.			
140959 R CENTAURI—						
	3456.1	8.0	Bl,	3477.1	7.1	Bl.
	3469.0	7.7	Bl,			
141567 U URSAE MINORIS—						
	3496.8	8.8	Br,	3523.6	8.8	B,
	3515.7	8.3	Pt,	3527.9	8.8	M.
	3520.6	8.9	Pc.			
141954 S BOOTIS—						
	3489.3	9.9	L,	3507.4	9.0	Gi,
	3495.4	9.4	Gi,	3515.7	8.5	Pt,
	3496.8	9.0	Br,	3516.7	8.6	Wf,
	3497.8	9.2	Sg,	3517.7	8.2	Sg,
	3500.3	9.2	L,	3520.7	8.3	Wf.
142539 V BOOTIS—						
	3489.3	9.5	L,	3517.7	10.7	Sg,
	3497.8	9.9	Sg,	3522.6	10.4	B,
	3500.0	10.1	Kd,	3522.6	11.0	Pc,
	3500.4	10.4	L,	3527.9	10.2	M,
	3515.7	10.8	Pt,	3553.6	10.2	Ro.
142584 R CAMELOPARDALIS—						
	3494.5	8.3	Gi,	3516.8	8.7	Wf,
	3496.8	8.0	Br,	3520.7	8.8	Wf,
	3509.5	8.5	Gi,	3523.6	8.8	B,
	3515.7	8.6	Pt,			
143227 R BOOTIS—						
	3496.8	7.0	Br,	3516.7	7.7	Su,
	3496.8	6.9	Sg,	3517.7	8.0	Sg,
	3515.7	7.8	Pt,			
144918 U BOOTIS—						
	3494.5	10.7	Gi.			
145254 Y LUPI—						
	3456.1	8.4	Bl,	3469.0	8.1	Bl,
	3459.0	8.2	Bl,	3477.1	8.3	Bl.
145971 S APODIS—						
	3456.1	10.0	Bl,	3477.1	10.3	Bl.
	3469.0	10.3	Bl,			
150018 RT LIBRAE—						
	3503.8	14.0	Pt.			
150519 T LIBRAE—						
	3503.8	11.3	Pt.			
150605 Y LIBRAE—						
	3489.7	[12.9	L,	3504.6	13.7	L.
151520 S LIBRAE—						
	3496.7	10.1	L,	3508.6	9.6	L.
	3503.8	9.5	Pt.			
151714 S SERPENTIS—						
	3489.7	[13.5	L,	3516.8	13.0	Wf.
	3498.6	13.7	L,			
151731 S CORONAE BOREALIS—						
	3496.9	9.2	Br,	3516.8	9.4	M,
	3496.8	8.9	Sg,	3516.8	9.0	Wf,
	3499.6	9.9	Cd,	3517.7	9.6	Ct,
	3500.1	9.7	Kd,	3517.7	9.5	Sg,
	3503.8	8.8	Pt,	3518.6	9.3	Pc,
	3505.7	9.3	Ct,	3520.7	9.0	Wf,
	3516.6	9.6	Cd,	3523.8	9.6	Ct.
	3516.7	9.5	Su,			
151822 RS LIBRAE—						
	3469.2	10.1	Bl,	3508.6	11.9	L.
	3496.7	11.4	L.			
152714 RU LIBRAE—						
	3496.7	8.8	L,	3504.6	8.3	L,
	3503.8	8.2	Pt,	3521.8	7.8	Sg.
152849 R NORMAE—						
	3456.1	7.6	Bl,	3477.1	8.0	Bl.
	3469.0	8.0	Bl,			
153020 X LIBRAE—						
	3469.2	12.2	Bl.			
153215 W LIBRAE—						
	3469.2	12.1	Bl,	3504.6	13.5	L.
153378 S URSAE MINORIS—						
	3496.8	9.7	Sg,	3517.7	9.0	Sg,
	3499.9	9.4	Kd,	3518.6	9.3	Ro,
	3503.8	8.8	Pt,	3553.6	8.9	Ro.
	3516.7	8.7	Su,			
153620 U LIBRAE—						
	3469.2	9.5	Bl.			
154020 Z LIBRAE—						
	3469.2	13.2	Bl.			

VARIABLE STAR OBSERVATIONS. March 20 to April 20, 1923—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
154428 R CORONAE BOREALIS—						
	3473.3	6.5	Kd,	3516.8	6.3	Wf,
	3478.3	6.3	Kd,	3516.8	6.2	M,
	3482.3	6.4	Kd,	3517.7	6.3	Ct,
	3489.7	6.0	L,	3518.6	6.2	Pc,
	3496.6	6.1	L,	3518.8	6.2	Pt,
	3496.8	6.0	Sg,	3518.8	6.4	Wf,
	3497.6	6.2	L,	3519.7	6.4	Wf,
	3498.8	6.3	Ct.	3519.7	6.6	Br,
	3500.0	6.0	Kd,	3520.7	6.2	Pt.
	3500.7	5.9	Sg,	3520.7	6.6	Wf,
	3502.3	6.0	Kd,	3521.7	6.5	Ct,
	3502.7	6.1	Pt,	3521.8	6.0	Sg,
	3503 8	6.4	Ct,	3522.7	6.8	Br,
	3503.8	6.1	Pt,	3523.8	6.5	Ct,
	3504.6	5.9	Gi,	3526.6	6.5	Pt,
	3504.7	6.1	L,	3527.6	6.5	Pt,
	3505.7	6.5	Ct,	3528.6	6.5	Pt,
	3505.9	6.0	Pt,	3528.7	6.7	Su,
	3506.9	6.1	Pt,	3528.8	6.2	M,
	3507.7	6.1	Pt,	3529.7	6.7	Pt.
	3508 6	6.2	L.	3529.7	7.1	Su,
	3509.7	6.1	Pt,	3535.6	7.5	Ly,
	3510.7	6.1	Pt,	3542.6	7.9	Ly,
	3514.7	6.3	Ct,	3543.6	8.7	Ly,
	3515 7	6.1	Pt.	3545.6	8.3	Ly,
	3515.8	6.0	Sg.	3546.6	9.0	Ly,
	3516.6	6.2	Pt.	3547.7	10.3	Ly,
	3516.6	6.3	Cd,	3553.7	[10.3	Ly.
	3516.7	6.3	Su,			
154536 X CORONAE BOREALIS—						
	3496.9	11.3	Br,	3503.8	12.0	Pt.
154615 R SERPENTIS—						
	3496.9	7.0	Br,	3516.8	7.0	Sg,
	3503.8	7.2	Pt.	3516.8	7.8	M.
154639 V CORONAE BOREALIS—						
	3496.9	9.6	Br,	3516.8	9.9	Wf,
	3503.8	8.5	Pt.	3516.8	10.2	M.
154715 R LIBRAE—						
	3503.8	11.0	Pt.			
155018 RR LIBRAE—						
	3496.7	10.9	L,	3529.8	8.8	Pt.
	3508.6	9.5	L,			
155229 Z CORONAE BOREALIS—						
	3497 0	12.5	Br.			
155823 RZ SCORPII—						
	3503.8	9.6	Pt.			
160021 Z SCORPII—						
	3469 2	10.5	Bl,	3508.6	11.0	L.
	3489.7	10.9	L,			
160118 R HERCULIS—						
	3503.8	8.3	Pt.	3517.7	9.3	Ct,
	3516.8	9.0	Sg,	3523.8	9.3	Ct.
	3516.9	9.0	M,			
160210 U SERPENTIS—						
	3497.0	10.1	Br,	3516 9	9.1	M,
	3503 8	9.8	Pt.	3524.8	9.0	Cd.
	3516.8	8.5	Sg,			
160221a X SCORPII—						
	3469.2	12.7	Bl.			
160519 W SCORPII—						
	3469.2	11.5	Bl.			
160625a RU HERCULIS—						
	3497.7	7.2	L,	3516.9	8.0	M,
	3503.8	9.8	Pt,	3517.7	7.7	Ct,
	3508.7	7.3	L,	3523.8	7.8	Ct.
	3516.8	7.7	Wf,			
160625b SX HERCULIS—						
	3497.7	8.5	L,	3518.8	7.7	Pt.
	3503 8	7.7	Pt,	3520.7	8.2	Wf,
	3506.9	7.3	Pt,	3520.8	7.7	Pt,
	3508.7	7.5	L,	3526.9	7.8	Pt,
	3515.7	7.7	Pt,	3527.6	7.9	Pt,
	3516.7	8.0	Pt.	3529.6	8.0	Pt.
	3516 8	7.8	Wf.			
161122a R SCORPII—						
	3469.2	11.1	Bl,	3503.8	12.0	Pt.
161122b S SCORPII—						
	3469.2	12.6	Bl,	3503.8	10.5	Pt.
161122c T SCORPII—						
	3503.8	10.9	Pt.			
161138 W CORONAE BOREALIS—						
	3497.0	11.0	Br,	3516.8	11.8	M,
	3499.6	11.0	Cd,	3516.8	11.6	Wf,
	3503.9	11.2	Pt,	3518.6	11.2	Pc.
161607 W OPHIUCHI—						
	3489.7	10.4	L,	3508.6	11.5	L.
	3503.9	11.2	Pt.			
162112 V OPHIUCHI—						
	3503.9	9.0	Pt.			
162119 U HERCULIS—						
	3497.0	8.3	Br,	3516.8	8.2	Wf,
	3503.5	8 0	Gi,	3516.8	8.8	Sg,
	3503.9	8.0	Pt,	3517.7	8.5	Ct,
	3505.7	8.4	Ct,	3523.8	9.0	Ct,
	3516.8	8.4	M.	3529.7	9.3	Su.
162319 Y SCORPII—						
	3504.7	[13.9	L.			
162807 SS HERCULIS—						
	3497.7	12.9	L,	3508.7	11.6	L.
	3503.9	12.0	Pt.			
162815 T OPHIUCHI—						
	3469.2	12.4	Bl,	3503.9	11 1	Pt,
	3497.6	10.9	L,	3508.7	10.8	L.
162816 S OPHIUCHI—						
	3469.2	[13.3	Bl.	3504.6	14.2	L.
163137 W HERCULIS—						
	3503.9	9.6	Pt,	3516.8	9.9	M.
163266 R DRACONIS—						
	3503.9	11.5	Pt.			
164319 RR OPHIUCHI—						
	3497.6	12.0	L,	3508.7	12.2	L.
	3503.9	11.4	Pt.			
164715 S HERCULIS—						
	3503.5	11.3	Gi,	3503.9	11.6	Pt.
164844 RS SCORPII—						
	3469.2	11.8	Bl.			

VARIABLE STAR OBSERVATIONS. March 20 to April 20, 1923—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
165030 RR SCORPII—				
	3469.2	10.5 Bl.		
165202 SS OPHIUCHI—				
	3503.9	12.4 Pt.		
165631 RV HERCULIS—				
	3503.9	14.5 Pt.		
165636 RT SCORPII—				
	3469.2	[14.0 Bl.		
170215 R OPHIUCHI—				
	3503.9	11.5 Pt.		
170627 RT HERCULIS—				
	3516.8	[14.5 Wf.		
170833 RW SCORPII—				
	3469.2	[13.5 Bl.		
171401 Z OPHIUCHI—				
	3503.5	8.4 Gi.	3503.9	8.6 Pt.
171723 RS HERCULIS—				
	3503.9	12.3 Pt.	3516.8	12.7 Wf.
172486 S OCTANTIS—				
	3459.0	11.7 Bl.	3469.0	12.3 Bl.
172809 RU OPHIUCHI—				
	3503.9	12.3 Pt.		
173212 RT SERPENTIS—				
	3497.7	9.9 L.		
173543 RU SCORPII—				
	3469.2	11.5 Bl.		
174135 SV SCORPII—				
	3469.2	10.5 Bl.		
174162 W PAVONIS—				
	3456.1	10.2 Bl.	3469.0	11.3 Bl.
174406 RS OPHIUCHI—				
	3503.9	11.5 Pt.		
175111 RT OPHIUCHI—				
	3503.9	10.4 Pt.		
175458a T DRACONIS—				
	3503.6	12.6 Gi.		
175519 RY HERCULIS—				
	3503.9	9.1 Pt.		
180531 T HERCULIS—				
	3497.7	8.9 L.	3516.8	7.6 Wf,
	3503.9	8.3 Pt,	3520.7	7.4 Wf,
	3508.7	8.3 L,	3524.8	8.0 Cd,
	3516.8	8.0 Sg.	3529.7	7.9 Su.
180565 W DRACONIS—				
	3505.9	9.7 Pt,	3519.6	10.2 Cd.
180911 NOVA OPHIUCHI #4—				
	3505.9	13.1 Pt.		
181103 RY OPHIUCHI—				
	3503.6	11.3 Gi,	3516.8	10.1 Wf.
	3505.9	11.1 Pt,		
181136 W LYRAE—				
	3497.7	9.2 L,	3516.8	9.6 Wf,
	3498.8	9.1 Ct,	3516.9	10.4 M,
	3503.8	9.6 Ct,	3521.8	10.4 Sg,
	3505.9	9.4 Pt,	3520.7	10.2 Wf.
182133 RV SAGITTARII—				
	3469.2	12.2 Bl.		
182224 SV HERCULIS—				
	3497.7	12.5 L.		
182306 T SERPENTIS—				
	3509.9	10.9 Pt.		
183308 X OPHIUCHI—				
	3497.6	6.9 L,	3509.9	6.6 Pt.
184134 RY LYRAE—				
	3509.9	10.5 Pt,	3528.8	10.6 M.
184205 R SCUTI—				
	3478.3	5.5 Kd,	3506.9	5.8 Pt,
	3480.3	5.5 Kd,	3508.6	5.6 L,
	3482.3	5.3 Kd,	3518.8	6.0 Pt,
	3483.3	5.3 Kd,	3520.8	5.9 Pt,
	3489.7	5.3 L,	3524.8	5.6 Cd,
	3496.7	5.0 L,	3526.9	5.6 Pt,
	3502.3	5.6 Kd,	3528.8	5.5 Pt,
	3503.8	5.5 Pt,	3528.8	5.0 M,
	3505.9	5.7 Pt.	3529.8	5.4 Pt.
184243 RW LYRAE—				
	3505.9	12.0 Pt.		
184300 NOVA AQUILAE #3—				
	3503.8	10.3 Pt,	3526.9	10.5 Pt,
	3506.6	10.2 Gi,	3528.8	10.6 M,
	3518.8	10.3 Pt,	3554.6	10.3 Ro.
185032 RX LYRAE—				
	3505.9	13.2 Pt.		
185512a ST SAGITTARII—				
	3489.7	8.9 L.	3508.7	9.8 L.
185634 Z LYRAE—				
	3489.7	[13.8 L,	3498.7	13.3 L.
190108 R AQUILAE—				
	3505.9	7.6 Pt.		
190529a V LYRAE—				
	3505.9	13.2 Pt.		
190907 TY AQUILAE—				
	3505.9	10.4 Pt.		
190926 X LYRAE—				
	3505.9	9.0 Pt.		
190967 U DRACONIS—				
	3506.9	13.1 Pt.		
191007 W AQUILAE—				
	3505.9	9.7 Pt.		
191019 R SAGITTARII—				
	3506.9	7.0 Pt.		
191033 RY SAGITTARII—				
	3497.7	[7.5 L,	3520.9	[10.0 Pt,
	3503.9	[9.0 Pt,	3526.8	[12.0 Pt,
	3505.9	[10.0 Pt,	3528.8	[11.5 Pt,
	3506.9	[10.0 Pt,	3529.8	[11.0 Pt.
191124 TY SAGITTARII—				
	3469.2	11.0 Bl.		
191319 S SAGITTARII—				
	3469.3	[12.2 Bl.		
191331 SW SAGITTARII—				
	3469.3	[12.9 Bl.		
191350 TZ CYGNI—				
	3505.9	10.0 Pt.		
191637 U LYRAE—				
	3505.9	9.7 Pt.		
193449 R CYGNI—				
	3505.9	10.2 Pt.	3521.8	9.5 Sg.
	3516.8	9.6 Wf.	3527.9	9.0 M.

VARIABLE STAR OBSERVATIONS. March 20 to April 20, 1923—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
193972 T PAVONIS—						
	3459.0	[13.2	Bl.			
194048 RT CYGNI—						
	3503.6	8.5	Gi.	3521.8	9.6	Sg.
	3505.9	8.5	Pt.	3527.9	9.5	M.
194348 TU CYGNI—						
	3527.9	[12.3	M.			
194604 X AQUILAE—						
	3505.9	9.9	Pt.	3527.9	11.0	M.
	3519.9	10.9	Wf.			
194632 χ CYGNI—						
	3505.9	11.8	Pt.			
194939 RR SAGITTARII—						
	3469.3	8.2	Bl.			
195142 RU SAGITTARII—						
	3469.3	7.8	Bl.			
195202 RR AQUILAE—						
	3527.9	10.8	M.			
195553 NOVA CYGNI 23—						
	3503.8	10.8	Pt.	3515.7	10.8	Pt.
	3505.9	10.9	Pt.	3518.8	10.9	Pt.
	3508.7	11.3	Gi.	3526.9	10.9	Pt.
	3509.7	10.8	Pt.	3528.8	11.0	Pt.
195849 Z CYGNI—						
	3503.6	8.7	Gi.	3516.8	9.5	Wf.
	3506.9	8.8	Pt.	3527.9	11.3	M.
195855 S TELESCOPII—						
	3469.3	13.0	Bl.			
200212 SY AQUILAE—						
	3497.7	9.4	L.	3519.9	9.4	Wf.
	3518.8	9.5	Pt.	3527.9	9.5	M.
200357 S CYGNI—						
	3516.8	12.8	Wf.	3518.8	12.3	Pt.
	3516.9	12.0	M.			
200514 R CAPRICORNI—						
	3520.8	9.5	Pt.			
200715a S AQUILAE—						
	3503.7	9.2	Gi.	3519.9	10.0	Wf.
	3516.9	10.2	M.	3520.8	10.6	Pt.
200715b RW AQUILAE—						
	3516.9	9.5	M.	3520.8	9.6	Pt.
200747 R TELESCOPII—						
	3469.3	[13.5	Bl.			
200812 RU AQUILAE—						
	3519.9	9.6	Wf.	3527.9	10.7	M.
200822 W CAPRICORNI—						
	3469.3	[11.6	Bl.			
200906 Z AQUILAE—						
	3508.7	13.2	Gi.	3520.8	12.4	Pt.
200916 R SAGITTAE—						
	3516.9	9.4	M.			
200938 RS CYGNI—						
	3504.7	7.5	L.	3528.8	8.4	M.
	3520.8	7.4	Pt.			
201008 R DELPHINI—						
	3489.7	9.9	L.	3520.8	8.5	Pt.
	3519.9	8.8	Wf.			
201130 SX CYGNI—						
	3516.8	10.3	Wf.	3516.9	10.5	M.
201139 RT SAGITTARII—						
	3469.3	8.4	Bl.			
201437b WX CYGNI—						
	3516.8	11.4	Wf.	3528.8	11.6	M.
	3520.8	11.8	Pt.			
201647 U CYGNI—						
	3506.7	8.9	Gi.	3527.9	9.0	M.
	3520.8	8.0	Pt.	3554.6	7.6	Ro.
	3521.8	9.0	Sg.			
202240 U MICROSCOPII—						
	3469.3	8.4	Bl.			
202539 RW CYGNI—						
	3527.9	9.0	M.			
202817 Z DELPHINI—						
	3519.9	11.7	Wf.	3520.8	11.6	Pt.
202946 SZ CYGNI—						
	3503.8	9.6	Pt.	3520.8	9.8	Pt.
	3505.9	9.6	Pt.	3526.8	8.8	Pt.
	3515.7	9.1	Pt.	3528.8	8.7	Pt.
	3518.8	8.8	Pt.	3528.8	9.2	Pt.
202954 ST CYGNI—						
	3516.8	11.7	Wf.	3520.9	11.8	Pt.
	3516.9	11.5	M.			
203226 V VULPECULAE—						
	3520.9	9.0	Pt.			
203429 R MICROSCOPII—						
	3469.3	10.2	Bl.			
203611 Y DELPHINI—						
	3519.9	10.9	Wf.			
203816 S DELFHINI—						
	3405.0	9.1	Nk.			
203847 V CYGNI—						
	3506.7	9.6	Gi.	3520.9	12.3	Pt.
	3516.9	11.8	Wf.			
204016 T DELPHINI—						
	3405.0	9.8	Nk.	3519.9	14.4	Wf.
204102 V AQUARII—						
	3520.9	8.0	Pt.			
204104 W AQUARII—						
	3504.7	8.8	L.			
204318 V DELPHINI—						
	3504.6	11.5	Gi.	3519.9	11.5	Wf.
204405 T AQUARII—						
	3526.9	10.0	Pt.			
204846 RZ CYGNI—						
	3503.6	11.3	Gi.	3520.9	12.1	Pt.
	3516.9	11.5	Wf.			
204954 S INDI—						
	3455.9	8.7	Bl.	3475.9	10.4	Bl.
	3468.9	9.7	Bl.			
205017 X DELPHINI—						
	3519.9	9.7	Wf.	3528.8	9.1	Pt.
205923 R VULPECULAE—						
	3503.7	11.5	Gi.	3526.9	13.5	Pt.
	3519.9	13.3	Wf.			
210129 TW CYGNI—						
	3516.9	12.6	Wf.			
210382 X CEPHEI—						
	3516.9	9.5	Pc.	3520.6	9.3	Wf.

VARIABLE STAR OBSERVATIONS, March 20 to April 20, 1923—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
210504 RS AQUARII—				
	3529.8	12.7 Pt.		
210516 Z CAPRICORNI—				
	3529.8	10.6 Pt.		
210812 R EQUULEI—				
	3526.9	6.4 Pt.		
210868 T CEPHEI—				
	3489.3	7.0 L,	3521.8	6.8 Sg,
	3500.4	7.2 L,	3527.9	7.4 M.
210903 RR AQUARII—				
	3527.9	10.5 M,	3529.9	10.6 Pt.
211614 X PEGASI—				
	3526.9	11.4 Pt.		
213244 W CYGNI—				
	3478.3	6.3 Kd,	3502.3	6.1 Kd,
	3482.3	6.3 Kd,	3504.7	5.9 L.
213678 S CEPHEI—				
	3509.4	9.2 Gi,	3526.9	8.6 Pt,
	3516.9	9.8 Wf,	3527.9	10.7 M.
213753 RU CYGNI—				
	3526.9	8.5 Pt.		
213843 SS CYGNI—				
	3489.7	11.6 L,	3509.7	11.8 Gi,
	3496.7	8.5 L,	3516.8	11.8
	3497.0	9.0 Br,	3518 8	11.8 Wf.
	3497.7	8.9 L,	3518.8	11.8 Pt,
	3498.6	8 7 L,	3519.8	11.7 Wf,
	3503.6	11.8 Gi,	3520 8	10.7 Pt,
	3503.8	11.8 Pt,	3521.9	12.0 M,
	3504.7	11.8 Gi,	3524.8	8 5 Cd,
	3504.7	11.3 L,	3526.9	9.0 Pt,
	3505.9	11.7 Pt,	3527.8	8.8 M,
	3506 6	11.8 Gi,	3528.8	9.5 Pt,
	3506.9	11.8 Pt,	3528.8	9.5 M,
	3508.7	11.8 Gi,	3529.8	10.5 Pt,
	3508.7	11.8 L,	3554.6	9.6 Ro.
213937 RV CYGNI—				
	3526 9	6.8 Pt,	3527.9	8.0 M.
214024 RR PEGASI—				
	3528.8	13.6 Pt.		
214247 R GRUIS—				
	3455.9	11.1 Bl,	3468.9	[11.4 Bl.
215934 RT PEGASI—				
	3528.8	10.3 Pt.		
220133a RY PEGASI—				
	3528.8	11.8 Pt.		
220133b RZ PEGASI—				
	3528.8	11.1 Pt.		
220412 T PEGASI—				
	3498.7	[11.0 L,	3504.7	11.5 L.
222439 S LACERTAE—				
	3504.7	11.3 Gi,	3528.8	12.8 Pt.
222867 R INDI—				
	3455.9	9.8 Bl,	3475.9	11.4 Bl.
	3468.9	10.9 Bl,		
223841 R LACERTAE—				
	3504.7	10.0 L,	3504.7	9.5 Gi.
230110 R PEGASI—				
	3528.8	8.1 Pt.		
230759 V CASSIOPEIAE—				
	3494.4	9.8 Gi,	3528.9	8.1 Pt.
	3508.4	8.7 Gi,		
231425 W PEGASI—				
	3504.7	10.3 L.		
233335 ST ANDROMEDAE—				
	3528 9	9.6 Pt.		
235053 RR CASSIOPEIAE—				
	3494.4	12.9 Gi.		
235209 V CETI—				
	3455.9	11.0 Bl.		
235350 R CASSIOPEIAE—				
	3498.4	8.3 Gi.		
235525 Z PEGASI—				
	3528.9	9.3 Pt.		
235855 Y CASSIOPEIAE—				
	3495.4	9.6 Gi,	3509.4	9.5 Gi.
235939 SV ANDROMEDAE—				
	3528.9	12.4 Pt.		

Total Observations: 1,366. Stars Observed: 355. Observers: 25.

COMMUNICATIONS.

Venus at Conjunction Nov. 24, 1922.—Knowing that a conjunction so near the node as that of November 24 would be a favorable time for seeing the atmospheric ring, we kept close watch of the planet here at Vassar as the phase diminished, and finally on November 19, the ring was seen. The observation was made by Miss Alberta Hawes, the assistant in the Observatory who has particularly good eyesight. She described the phenomenon as follows: "The phase of Venus was about 0.01 and the bright portion appeared as a thin crescent which narrowed down into a fine thread of light encircling the entire disc of the planet. This was seen very clearly to extend through 270° but a closer examination was required to see the complete circle which was however distinctly visible. The lower (northern) horn was slightly more pronounced

than the upper. The phenomenon was easily observed in spite of the fact that the field of view was bright with the sunlight."

The writer was not able to see more than 270° of the ring. Unfavorable weather prevented further observations of it until after the 24th. November 29 was the first clear day after the conjunction, and we looked at Venus about noontime, but neither one of us was able to see more than 270° of the ring, but the air was not very steady.

Our telescope has an objective of twelve and a quarter inches, and is provided with a cardboard dew-cap which extends 10 inches beyond the object glass, and is dark on the inside. It remains permanently on the telescope, and it was not considered necessary to shield the object glass from the rays of the sun while making the observations.

CAROLINE E. FURNESS.

Vassar College, Poughkeepsie, N. Y., May 31, 1923.

Occultation of Venus, January 18, 1923.— The occultation of Venus by the moon on January 18 was observed here. We were prepared to note the times of contact, but to our great disappointment the motor which drives the dome failed to work, and we had to content ourselves with the view through the smaller telescopes. However, this made it seem more of a spectacle, and as such it was of unrivalled beauty.

When I went out to open the telescope house, the sky was still dark and wonderfully clear. Venus was distant from the moon more than the moon's diameter. Then, simultaneously, the sky grew brighter and the moon moved closer to Venus, but so obliquely that it seemed almost as if it would glide by without hiding it, and daybreak was almost at hand before the first contact took place. Even then Venus clung to the tip of the moon for a long time and in the pale light of dawn sparkled like a brilliant diamond set on a silver band. Through the telescope the difference in albedo between Venus and the moon was quite striking.

Venus emerged from occultation before sunrise, but so brilliant was it that it was easily seen at eight o'clock, and was still distinctly visible an hour later. Even at 11:30 it could be seen by those with good eyesight.

CAROLINE E. FURNESS.

Vassar College, Poughkeepsie, N. Y., May 31, 1923.

A Curious Illusion. — If some evening when Spica and Arcturus are near the meridian we face the east, and draw an imaginary line through them towards the north, we shall find that it passes to the north of η Draconis. This is the middle one of the three bright stars just south of the bowl of the little dipper. The line therefore passes between them and the pole star. Now face to the west and draw the the line. We shall find that it now passes to the south of η, that is on the other side of it.

What appears to us as a straight line in the heavens is really a curve. A really straight line passes nearer to the zenith than we think. Objects in the zenith appear smaller than they are, just as objects near the horizon appear larger. If our observations of meteor tracks were more accurate than they usually are, this illusion might have a bearing in our discussion of them.

WILLIAM H. PICKERING.

Mandeville, Jamaica, B. W. I., May 8, 1923.

A Meteoric Satellite? — Mr. Moran's note in POPULAR ASTRONOMY for May, p. 362, under this heading is of interest, although his data are rather scant. His facts seem to be that the dark object observed crossed the nearly full moon near its center in about seven seconds, and that its estimated diameter was 3".5. There are two solutions of the problem, the first of which involves a cubic equation, but gives as an approximate result that, assuming a circular orbit, the distance of the object, if near the zenith, would be 6500 miles from the earth's center, that its velocity would be 3.5 miles per second, that its period of revolution would be about 180 minutes, or three hours, and its diameter 235 feet.

The other solution involves a bird, whose cross section was equivalent to a disk 3.5 inches in diameter, located at a distance of 3.25 miles, and flying at a transverse speed of 15 miles per hour. The object first described would certainly be a very interesting body—unfortunately the latter is the more plausible explanation.

WILLIAM H. PICKERING.

Mandeville, Jamaica, B. W. I., May 19, 1923.

GENERAL NOTES.

Dr. R. H. Baker, who has been Head of the Department of Astronomy at the University of Missouri, has been appointed Head of the Department of Astronomy at the University of Illinois to take effect September 1, 1923. He expects to be associated with the Lick Observatory Eclipse Expedition.

Dr. Albert A. Michelson, of the University of Chicago, lectured before the Department of Astronomy of the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., on April 27, his subject being "The Measurement of Stars by Light Waves." The audience was large and accorded Dr. Michelson an enthusiastic reception.

Professor Bernhard H. Dawson, chief astronomer in the Observatory of La Plata, left Argentina in the latter part of May for six months' leave of absence which will be spent chiefly in the United States.

Professor E. W. Brown, who has spent the past five months at Honolulu, returned on May 1 to Yale University in excellent health. Professor Brown and Professor Bailey of Harvard were recently elected members of the National Academy of Sciences.

New Telescope for Yale. — Yale University Observatory has awarded a contract to the J. B. McDowell Company of Pittsburgh for the optical parts of a 26-inch photographic telescope of thirty-six feet focal length. In addition to the principal lens there will be a 10-inch visual following objective of thirty-six feet focal length and an 8-inch correcting lens to transform the color correction of the principal lens into one that will make it suitable for visual observations. It is expected that this telescope will be completed in one year. It is to be erected at some site south of the equator not yet chosen, probably in South Africa or in New Zealand.

Soldner's Computation of the Deflection of Light at Sun's Limb.—The following extract from a private letter from Professor Edwin B. Frost is of great interest at the present time. After speaking of Professor Campbell's address before the National Academy of Sciences in April on the Crocker Eclipse Expeditions, Professor Frost says:

"The evidence that there is a deflection of 1".75 at the sun's limb is unquestionable. Whether it is a proof of Einstein's theory is another matter. See has referred to Soldner's work and we have looked it up in Bode's Astron. Jahrbuch for 1804, published in 1801. He there derives, for the half deflection, on the corpuscular theory, 0".84. With modern data, this becomes 0".87 for the *half deflection*. Few people seem to have noticed this work of Soldner, and I called it to the attention of several at Washington, but I cannot see how he can be right, and at the same time the Einstein physicists who assert that the *whole* deflection ought to be 0".87 on the corpuscular Newtonian theory. If Soldner is right, then the deflection was accurately predicted 120 years ago, and the successful result of the eclipse expedition might be regarded as a confirmation of Soldner rather than of the Einstein hypothesis. This subtracts nothing from the immense credit due to Einstein for developing a new point of view in the philosophy of physics, and he gets his test by a wholly independent way from Soldner. I want some of our competent mathematical physicists to settle this matter. Campbell did not refer to it; in fact, he did not discuss Einstein's theory at all."

Courtesy of the Mexican Government to Eclipse Observers.—The following letter decribes the many valued courtesies and acts of assistance which the Mexican National Government, the Governor of San Luis Potosi, the Council of Mexico City, the Mexican National Railways and Professor Gallo, the Director of the National Observatory at Tacubaya, are prepared to offer to the astronomers of other countries who will be in Mexico to observe the total solar eclipse due to occur on September 10, 1923:

"Tacubaya, D. F.
May 24th, 1923.

"Dear Dr. Campbell:

"I have the pleasure to inform you, in your capacity as Chairman of the Eclipse Committee, that the Mexico City Council has declared guests of honor of the Capital the astronomers coming to observe the eclipse.

"The Governor of San Luis Potosi will provide for all the necessities of the expedition going to Berrendo, three kilometers south of the central line and will give them all kinds of facilities. Said Governor wishes me to convey to you his invitation to visit San Luis Potosi, capital of the State, and to have an exhibition of the results obtained or to hold a meeting there. The expenses of the party during their stay in that city will be met by the Governor. The expenses of the astronomers during their visit to Mexico City will be paid by the Council.

"Up to this day the National Railways offer a discount of 50 per cent of fares from the boundary to Mexico City and to points where the eclipse will be visible.

"So I have the pleasure to invite you most heartily to come and visit us.

"Hoping that you will accept the invitation, and with kind regards, I am,

"Yours sincerely,
(Signed) JOAQUIN GALLO."

"Doctor W. W. Campbell
President of the California University
Berkeley, California."

I have sent copies of Professor Gallo's letter to all astronomers who are

looking toward observing stations in Mexico, but POPULAR ASTRONOMY will probably reach others who are interested and, further, the kind offers of the Mexican authorities should be made known to all members of the astronomical profession.

W. W. CAMPBELL.
Chairman, Eclipse Committee,
American Astronomical Society.

Nova in Messier 83.— A telegram received here May 8 from the Lowell Observatory, Flagstaff, Arizona, announces the discovery by Lampland on May 5 of a new star in the spiral nebula Messier 83, N. G. C. 5236. Referred to the nucleus of the nebula, the nova, which is approximately of the fourteenth magnitude, has the position angle 73° and a distance of 2′.1.

The position for 1900 of N. G. C. 5236 is $13^h\ 31^m.4$, — 29° 21′. It is "a bright and unusually beautiful spiral, 10′ x 8′. The nucleus is 20″ in diameter and very bright. There is a large number of almost stellar condensations in the rather open whorls." (Description by Curtis in Lick Observatory Publications, **13**, p. 34, 1918.)

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

Faint Red Star of Large Proper Motion.— In the course of a study of faint variables in the star clouds of Sagittarius, the writer has found on two pairs of photographs, made with the Bruce telescope in Arequipa and separated by an interval of 23 years, a star for which the annual proper motion is eight tenths of a second of arc in the position angle 225°. The position of the star in 1899.8, referred to the equinox of 1900, is $18^h\ 57^m\ 41^s$, — 13° 42′.0.

The photographic magnitude is 16.2. A plate made in 1918 with a yellow filter indicates that the color index is considerably in excess of one magnitude.

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

Seven New Variable Stars in Monoceros.— On a series of seven recent photographs, made with the 16-inch Metcalf telescope, Miss Cannon has found the following new variable stars in the constellation Monoceros:

Harvard Variable	R. A. 1900 h m	Dec. 1900 ° ′	Maximum	Minimum
3657	6 45.4	+0 7	12.8	13.5
3658	6 45.8	—1 19	11.4	12.1
3659	6 51.5	+0 19	11.9	12.7
3660	6 52.9	—0 15	11.0	12.2
3661	6 54.5	+2 21	12.2	13.1
3662	6 57.8	+0 46	12.4	13.2
3663	6 58.5	—0 3	13.2	14.0

The periods are short. The magnitudes were obtained by a comparison with the sequence in Selected Area, No. 98, and are rather uncertain because of the large distances from the sequence.

The new variables are in a part of the Milky Way that is rich in telescopic stars. The plate covers approximately thirty-four square degrees, and each exposure shows about forty-one thousand stars. Since but one other known variable

lies in this region, it is seen that for only one star in five thousand is variability proved on these seven plates, which show stars to the fifteenth photographic magnitude.

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

Suspected Variability in Star and Nebula. — A telegraphic communication received from Professor D. W. Morehouse, Acting President of Drake University, Des Moines, Iowa, calls attention to possible changes in brightness and color of the star B. D. +34°980, for which the position for 1900 is $5^h\,9^m.7$, +34° 12′. He also calls attention to possible variations in the brightness of the surrounding nebula, which is No. 405 in Dreyer's first Index Catalogue.

The visual magnitude of the suspected star is 5.8. The spectral class is B0p, the peculiarity in the spectrum consisting in the exceptional strength, for a star of Class B0, of certain lines, especially the helium line 4686. The star appears on several series of Harvard photographs, and there is some evidence of variability, both in the star and in the surrounding nebulosity, but the brightness is too great to permit accurate estimates of the magnitude.

The spectrum of the star is described in Harvard Annals **56**, p. 105. Hubble has studied the star and nebulosity at Mount Wilson (Mt. W. Contr., Nos. 241 and 250, 1922).

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

R Coronae Borealis. — Since December, 1921, the important irregular variable R Coronae Borealis, 154428, has remained at nearly constant maximum magnitude, between 6.0 and 7.0. Telegrams received at the Harvard Observatory in April from Mr. W. F. H. Waterfield, of Nakusp, B. C., and Mr. C. Y. McAteer, of Pittsburgh, Pa., indicate that the brightness of the star began to decrease early in April, 1923. The most recent observation made at the Harvard Observatory, on May 7, 1923, shows that the star was then of magnitude 10.1. Although the change was gradual during April, the star now appears to be decreasing rapidly. It has not previously been fainter than the tenth visual magnitude since September, 1917, when it decreased to magnitude 13.6.

As the fluctuations in the brightness of this variable are exceedingly irregular, observations at frequent intervals are much needed.

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

Proper Motions near A. G. Hels. 13170. — Lindblad has called attention to three stars in the neighborhood of A. G. Hels. 13170 for which the measures of minimum effective wave-length indicate absolute magnitudes of the order of +8 to +9. Two of these stars occur in the Bonn Durchmusterung as +57°2514 and +56°2779, respectively. No catalogue positions could be found, but from a comparison of the Bonn Durchmusterung positions with those on his plates, Lindblad concluded that it was not improbable that these two stars had proper motions of the order of $0''.5$ annually in the direction of increasing right ascension.

In order to test this suggestion, two Harvard plates of the region, separated

by an interval of twenty-three years, were compared by Dr. Luyten in the blink-microscope. No proper motion could be detected. The scale of the Harvard plates is such that a proper motion of 0".5 annually corresponds to a linear displacement of one-sixteenth of a millimeter in twenty-three years. The motion of A. G. Hels. 13170 (0".87 annually) was detected at a glance, and, in general, proper motions of the order of 0".3 annually are easily perceived on the plates.

Preliminary measures of these three stars, and also of A. G. Hels. 13170 and of No. 7 of Lindblad's list, lead to the estimates of proper motion tabulated below. The spectra, absolute magnitudes, and parallaxes are those given by Lindblad in his thesis. The spectra of the first and fourth were found by Luyten, using the 36-inch refractor of the Lick Observatory, to be of Class F5 and K, respectively.

The mean error of each motion can be estimated at 0".04; accordingly we can only say that these four stars do not appear to have a considerable proper motion.

Star	Vis. Mag.	R. A. 1855 h m	Dec. 1855 ° ′	Spectrum	Abs. Mag.	Parallax ″	Harvard Proper Motion ″
57°2514	10.4	22 17.2	+57 14	G2	+ 8	0.03	0.04
Lb. No. 3	11.1	18.4	+57 9	G-K	+ 8	0.02	0.07
Lb. No. 7	10.7	18.8	+56 20	F7	+ 5	0.007	0.04
56°2779	10.8	22.2	+56 23	K8	+ 9	0.04	0.07
Hels. 13170	9.2	22.8	+56 58	Mb	+11.2	0.25	0.96

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

Reported Nova in Cygnus.—A cablegram signed by Dyson and Strömgren, received May 11 from Copenhagen and distributed to the American subscribers of the telegraphic service, announced the discovery by Anderson on May 8, at 12^h Greenwich Mean Time, of a nova of the fifth magnitude in the position 21^h 20^m 40^s, +35° 56′.

A telegram received from Professor E. B. Frost, Director of the Yerkes Observatory, reports that visual and photographic observations made on the night of May 12 fail to show any nova near the position given above.

On several Harvard photographs of the region within ten degrees of the reported position, made on the night of May 13, stars fainter than the eleventh magnitude are shown. No star appearing to be a nova is found.

Harvard College Observatory Bulletin 786.
Cambridge, Massachusetts, May 14, 1923.

The nova above referred to was announced by Mr. T. D. Anderson, of Innerwick, Scotland, who was the discoverer of Nova Aurigae in 1892 and Nova Persei in 1901. It was therefore with confidence that astronomers turned to the heavens, on receipt of the telegram, in the expectation of obtaining further data as to the spectrum and light changes of these strange objects. Unfortunately either the telegraphed position of the nova was wrong or Mr. Anderson must have confused the object seen with a neighboring star, for photographs taken at Greenwich and the Yerkes Observatory show no new star near the place indicated.

In the *English Mechanic* for May 18, the original telegram is given as follows:

"Nova Cygni, half degree north, following 70 Cygni, fifth magnitude. Brighter than 70, but fainter than 72. Rough estimate of position with a binocular. Right ascension 21 degs. 25 m. 25 s. North declination 37 degs. 6 m. Anderson, Thurston Mains, Innerwick."

Class K Stars of Peculiar Motion. — The following list contains stars of spectral class K0 with unusually small tangential velocities. For all but one, the parallax is greater than the total proper motion. The probable error of the proper motion is given in thousandths of a second of arc. The tangential and radial velocities in the last two columns are expressed in kilometers a second. Dr. Luyten has computed the tangential motion on the basis of a weighted mean of the tabulated values of the parallax.

Star	R.A.1900	Dec.1900	Vis. Mag.	Proper Motion	Trigon. Parallax	Spectroscopic Parallax Harv.	Spectroscopic Parallax Mt.W.	T	V
	h m	° ′		″	″	″	″		
ν Psc	1 36.2	+ 4 58	4.7	0.021 ± 2	0.054	0.014	0.017	3.1	+ 0.9
ν Aur	5 44.6	+39 7	4.2	0.008 ± 2	0.021	0.015	0.016	2.1	+ 9.6
47 Aur	6 22.6	+46 44	6.0	0.007 ± 5	0.015	....	0.008	3.0	— 46.8
6 CMi	7 24.2	+12 13	4.8	0.019 ± 3	0.023	0.012	0.013	5.3	— 14.6
ι Dra	15 22.7	+59 19	3.5	0.010 ± 2	0.036	0.023	0.021	1.6	— 10.2
ζ Cep	22 7.4	+57 42	3.6	0.012 ± 1	0.025	0.023	0.024	2.4	...

Harvard College Observatory Bulletin 787.
Cambridge, Massachusetts, May 18, 1923.

Nova in Messier 83. —A letter from Professor Edwin B. Frost, Director of the Yerkes Observatory, contains the following memorandum by Professor Van Biesbroeck concerning an observation made at the Yerkes Observatory of the nova discovered by Lampland in Messier 83 (H. B. 786):

An exposure of 30 minutes, with the 24-inch reflector on May 9, $16^h\ 22^m$ G. M. T., shows a fourteenth magnitude star in position angle 62° and 124″ distant from the nucleus, which is presumably Lampland's nova, although the position angle is not in agreement with the telegraphic announcement of 73°. On the engraving in Lick Observatory Publications, Vol. 13, p. 43, Fig. 7, of a negative by Curtis (date not given) there is a doubtful image, not brighter than the sixteenth magnitude, which, if real, may be the nova. On an exposure of one hour made by Mr. Barnard with the 6-inch Bruce telescope, May 20, 1905, the object is missing ([14^m5). It is not visible on the Franklin-Adams Charts, No. 57 (1910, May 6) and No. 58 (1910, June 1), which show a neighboring star that on Mr. Van Biesbroeck's plate was a trifle fainter than the nova on May 9.

Harvard College Observatory Bulletin 787.
Cambridge, Massachusetts, May 18, 1923.

Period of X Monocerotis.—The variable, X Monocerotis, *065208*, discovered by Mrs. Fleming in 1898, and observed at Harvard somewhat infrequently at first, but more completely later by the members of the American Association of Variable Star Observers, has until very recently been considered irregular in period. Müller has discussed the Harvard published photographic and visual observations and finds that a period of 157 days satisfies the data fairly well, but there are outstanding irregularities (G. u. L., **1**, 206). Although

Hartwig formerly assigned no value, in the latest variable star ephemeris he gives a period of 155 days.

From a discussion of all the available visual observations from 1903 to 1923, which yield 38 maxima and 33 minima, Mr. Campbell finds that the formula

$$\text{Max.} = \text{J. D. } 2415997 + 155^{d}.3 \cdot E$$

satisfactorily represents the observations. There are indications of small irregularities in this period; but the average deviation of the determinations of maxima is only $0^{d}.4$, while for the minima, the value is $7^{d}.3$. The mean value of $M - m$ is 84^{d}, and $(M - m) / P = 0.54$.

The mean light curve is very smooth and is typical of many long period variables with a broader maximum than minimum. The decrease in light is more rapid than the increase, and the mean range is 1.7 magnitudes.

It appears, therefore, that this star can now be considered as a regular long period variable with small range in brightness.

Harvard College Observatory Bulletin 787.

Cambridge, Massachusetts, May 18, 1923.

Offer of Eclipse Apparatus.—The following letter from Professor Warren K. Green arrived too late to be used in connection with Dr. Fath's article on the eclipse. We hope some one may be able to take advantage of the kind offer of eclipse apparatus:

Owing to extensive repairs and alterations which are to be made in the Amherst College Observatory this summer it will be impossible for us to make any plans for observing the eclipse.

We have several lenses which were used by Professor Todd in his various expeditions and we shall be very glad to place these at the disposal of any institution or individuals who will give security for their return.

I have not been able to find any time since coming to Amherst to test out the lenses personally, but I am informed that several of them are of excellent quality. There are several portrait lenses of from 3 to 4 inch aperture and from 2 to 3 feet focal length. We also have the pair of achromatic doublets of 3 inch clear aperture and 11 feet focal length which were made by the Clarks for Professor Todd.

I trust that this letter may reach you in time so that you may insert a notice of this offer of loan in your eclipse number.

WARREN K. GREEN, *Director.*

The Thirtieth Meeting of the American Astronomical Society will be held at the Mount Wilson Observatory, Pasadena, California, September 17 to 19, 1923. The following provisional program and circular of information have been communicated by the Secretary, Joel Stebbins, director of Washburn Observatory.

PROGRAM.
(Subject to change.)

MONDAY, SEPTEMBER 17, 1923

At the University of Southern California, Exposition Park, Los Angeles.

9:00 A. M. Meeting of the Council.
10:00 A. M. Session for papers.
12:15 P. M. Luncheon, University Cafeteria, and Research Conference, A. A. A. S., and affiliated societies.
2:00 P. M. Symposium on Eclipse, Bovard Auditorium.
8:00 P. M. Address by the President of the Pacific Division, American Association for the Advancement of Science, Bovard Auditorium.

9:00 P. M. Reception by the University of Southern California, Bovard Auditorium.

TUESDAY, SEPTEMBER 18

At the Laboratory of the Mount Wilson Observatory, Lake Avenue and Santa Barbara Street, Pasadena.

9:00 A. M. Meeting of the Council. Inspection of laboratories, shops, etc., of the Mount Wilson Observatory.
10:00 A. M. Session for papers.
12:15 P. M. Luncheon, Government Building.

At the Norman Bridge Laboratory of Physics, California Institute of Technology, Wilson Avenue and East California Street, Pasadena.

2:00 P. M. Joint session with the American Physical Society.
4:00 P. M. Inspection of the laboratories of the California Institute of Technology.
5:00 P. M. Motor cars leave for the University of Southern California. (Transportation charge to be announced later.)

At the University of Southern California.

6:30 P. M. Dinner.
8:00 P. M. Address, "The La Brea Asphaltum Beds," by Dr. J. C. Merriam, President of the Carnegie Institution of Washington.
10:00 P. M. Motor cars return to Pasadena.

WEDNESDAY, SEPTEMBER 19.

9:00 A. M. Stages leave the Laboratory of the Mount Wilson Observatory, Lake Avenue and Santa Barbara Street, Pasadena, for Mount Wilson.
12:30 P. M. Luncheon at the Monastery.
2:00 P. M. Session for papers. Election of officers.
4:30 P. M. Inspection of solar apparatus. Walk, The Rim Trail.
6:15 P. M. Dinner at Mount Wilson Hotel. ($1.25 per plate.)
8:00 P. M. Inspection of 60-inch and 100-inch Hooker reflecting telescopes.
10:00 P. M. Stages leave for Pasadena, for the convenience of those who do not wish to remain on Mount Wilson over night.

THURSDAY, SEPTEMBER 20.

6:30 A. M. The tower telescopes will be in operation, illustrating various methods of solar observation.
9:00 A. M. Stages leave for Pasadena.

CIRCULAR OF INFORMATION.

The thirtieth meeting of the American Astronomical Society will be held on September 17 to 19, 1923, at Los Angeles, Pasadena, and Mount Wilson, California, in conjunction with the summer meetings of the American Association for the Advancement of Science and the Astronomical Society of the Pacific. The date has been chosen to give observers of the total solar eclipse on September 10 opportunity to get to the meeting.

The opening sessions will be at the University of Southern California, Exposition Park, Los Angeles, on Monday, September 17. On the invitation of the Mount Wilson Observatory other sessions will be at the Laboratory of the Observatory in Pasadena, on Tuesday morning, September 18, and at the Observatory on Mount Wilson, Wednesday, September 19. A joint session with the American Physical Society will be held at the Norman Bridge Laboratory, California Institute of Technology, Tuesday afternoon, September 18.

Members of the Society are recommended to secure their hotel accommodations in Pasadena. The following are available:

Hotel Maryland and Hotel Vista del Arroyo.

Single room with bath.....$5.00
Double room with bath..... 7.00
Breakfast $1.25, luncheon $1.50, dinner $2.00

Crown Hotel.

Room with bath.....$1.50 and $2.00
Breakfast 75c, luncheon 75c, dinner $1.25

Those desiring accommodations should communicate directly with the hotel management.

The address for mail and telegrams is care of Mount Wilson Observatory, Pasadena, California.

The Laboratory and offices of the Observatory in Pasadena, at Lake Avenue and Santa Barbara Street, are easily reached by trolley and bus lines. Pasadena and Los Angeles are connected by the trolley lines of the Pacific Electric Railway. Oak Knoll and Short Line cars leave the Los Angeles terminus, Sixth and Main Streets, at frequent intervals throughout the day.

Special stages for members of the American Astronomical Society, Section D, of the American Association, and the Astronomical Society of the Pacific will be provided for the trip to Mount Wilson, leaving the Pasadena office of the Observatory at 9:00 A. M., Wednesday, September 19. Fare, up $2.00, down $1.50, round trip $3.00.

Accommodations on Mount Wilson may be secured at the Mount Wilson Hotel. Rooms, $1.50 to $4.00. Meals, breakfast $1.00, luncheon $1.25, dinner $1.25.

Those desiring transportation and rooms on Mount Wilson should notify Professor A. H. Joy, Observatory Office, Pasadena, as early as possible, and on no account later than noon of Tuesday, September 18. Wishes in the matter of return transportation, whether on the night of September 18 or on the morning following, should similarly be communicated to Professor Joy.

As a pleasant variant of the journey, those who desire may walk from Mount Wilson to Alpine Tavern, Mount Lowe, returning thence to Pasadena or Los Angeles by trolley. Fare $1.40 and $1.60. The walk, six miles, is one of the most attractive in the neighboring mountains.

At the symposium on eclipses on Monday afternoon, it is expected to have a number of brief informal reports from eclipse observers, but this program will not be arranged until a day or so before the meeting. At the joint session with the American Physical Society on Tuesday, there will be papers of common interest to astronomers and physicists.

The Constitution of the Spiral Nebulae.—The following remarks by Professor Lindemann, taken from the report of the meeting of the Royal Astronomical Society (England) on April 13, 1923, are very interesting in that they suggest a new theory of the constitution of the spiral nebulae, namely that they are enormous clouds of dust driven out from the Milky Way by light-pressure from the aggregate of the stars of the galaxy.

"The view that spiral nebulae form external galaxies similar to our own will probably have to be given up, if Van Maanen's determinations of rotations are confirmed. In this paper an attempt is made to examine the alternative view of their constitution.

"The old view, that they are composed of stars and form island universes, of course explains their spectrum, is not in disagreement with their observed shape, and allows of a plausible explanation of the appearance in them from time to time of bright objects, which are interpreted as 'novae' analogous to those appearing in the galaxy. It does not explain the fact that they have usually high receding velocities, nor why they, in general, avoid the plane of the galaxy, nor, finally, why the centre should be redder than the edges, as observed by Reynolds.

"The alternative hypothesis is that the spirals consist of particles of dust. Particles whose diameter is of the order of 10^{-4} cm. are repelled from bodies like the sun, owing to light pressure and the effect of the repulsion from all the stars would result in their accumulation in regions in which the radiation density is low. Clouds of dust collecting in these regions will, of course, be unstable and will sooner or later be expelled from the galaxy. It is obvious that they

would tend to avoid the plane of the galaxy on account of its shape, as the gradient of radiation would be much higher at right angles to it. The velocities would, of course, be predominantly receding, and very high speeds can be accounted for, as light-pressure may exceed gravity many times. The whole theory is, of course, bound up with the admission that the light of the spiral nebula is reflected light from the stars. Unless one admits that the spirals are external galaxies, *i. e.*, that their light is intrinsic stellar light, this would appear to be the only possible way in which one can account for their continuous spectrum. For if particles are small, their light cannot be ascribed simply to temperature radiation. Firstly, it would be very difficult to explain why their temperature should remain high for an appreciable period. Secondly, even if one could account for this, one could not escape the conclusion that they would speedily evaporate and give rise to a line-spectrum. The reflection hypothesis does not appear to lead to any grave difficulties. If the sun were not present, the total light from the stars in our region would, if reflected diffusely, correspond to a luminosity per square degree equal to the light from a star of 5.2 magnitude, and this might well be exceeded in the neighbourhood of bright stars. The reflection hypothesis gives the right spectra, namely, that of the average galactic stars. It also explains the phenomenon of the reddish centres. The particles are by hypothesis so small as to be repelled by light-pressure. It is evident that compared to gravitational attraction the radiation pressure between the larger particles will be relatively less than that between the smaller particles, so that the periphery will consist of smaller particles than the centre, and the small particles will, of course, reflect blue light better than red light.

"The most difficult point to explain on this theory is the appearance of the so-called 'novae.' The only explanation that occurs to one is that these novae are caused by comet-like clouds of stones passing through the spiral. The collisions of the nebular dust particles will heat and finally vaporize the stones, and the interspace between them will rapidly fill up with gas. This gas will maintain its high velocity relative to the nebula until collisions with the nebular particles bring it to rest, and a large amount of energy will be generated and radiated. On this view the novae would be analogous to our meteoric showers. In the paper I have inserted what seemed to me the most probable average values, and have examined whether they would lead to any absurd results, if this view of the 'novae' is adopted. As far as I can see, the quantities worked out quite reasonably. The total mass of the nebula seems to be less than 10^{37} grams—*i. e.*, some thousand times the sun's mass.

"I do not pretend to have proved, or even to have convinced myself, that this theory is right, but it seems to me that it is more probable than the old theory and therefore worth while putting forward as a basis of discussion."

Astronomy in Russia.—In the spring of 1921 a resolution was passed by the Russian Imperial Council of Scholars for the purpose of organizing astrophysical research in Russia to found a central astrophysical observatory to which should be joined several affiliated observatories. The final shaping and carrying out of the undertaking was entrusted to a committee on organization with an astrophysicist as councillor. Professor A. A. Stratonow, from whose initiative the entire plan had originated, was named as chairman of the organizing committee. The central astrophysical observatory was established at Moscow and, as a second step, the former Observatory at Taschkent and the new Astronomical

Institute at Novotscherkassk on the Don were given into its charge as affiliated institutions. In August, 1922, the further development of the plan was suddenly interrupted by the oppressive interference of the Russian government which imprisoned Professor Stratonow, together with forty other Moscow professors and authors, on the charge of generally anti-soviet principles without alleging any definite facts. They regained their freedom only on condition of leaving Russia immediately and under threat of the death penalty in case of their return. Similar treatment was meted out by the Russian government in Petrograd and several other large cities, but in less degree. Scholars were especially affected. Professor Stratonow has taken refuge in Berlin. His successor as chairman of the organization of the Russian central astrophysical observatory is Professor B. Fessenkoff.

United States Civil Service Examination.—The United States Civil Service Commission announces the following open competitive examination for computer:

The examination will be held throughout the country on July 11 and 12. It is to fill vacancies in positions as follows, at the entrance salaries specified: Computer in the Naval Observatory, at $3.28 to $3.76 a day; assistant in the Nautical Almanac Office, at $1,200 a year; assistant in the Naval Observatory, at $1,400 a year; and positions requiring similar qualifications. To the salaries named the increase of $20 a month allowed by Congress is added.

The scope and character of this examination are such that applicants not having a good knowledge of mathematics through calculus, of spherical and general astronomy, logarithms and a fundamental knowledge of either French or German will not be able to attain a passing grade in the written examination.

For the position of computer and assistant in the Naval Observatory, preference will be given to male eligibles having had experience in the use of astronomical, physical, or engineering instruments.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil-service examiners at the post office or customhouse in any city.

Venus Near the Sun on September 10.—At the time of the Total Solar Eclipse on September 10 Venus will be about 37′ east and 1° 15′ north of the sun's center, so that it may be photographed on many of the eclipse plates with the corona.

Erratum. — In an article entitled "The Thirty-eight Stars Having the Largest Known Parallaxes," which appeared in POPULAR ASTRONOMY for February, 1922, the radial velocity of α Centauri was incorrectly given. In the seventh column of the table on page 96, read —22 instead of +22 for the radial velocity of this star, and in the eleventh column read +28000 instead of —28000 for the time of its minimum distance from the earth.

This misprint first occurs in the Lick Observatory Bulletin, volume 7, page 57, whence it was copied into Voute's First Catalogue of Radial Velocities, page 140.